SCIENTIFIC AGRICULTURE

Vol. XI. JANUARY, 1931 No. 5

RECENT PROGRESS IN THE STUDY OF JONATHAN BREAKDOWN IN CANADA.

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[Received for publication October 6, 1930]

The "breakdown" discussed in this paper occurs in apples grown in British Columbia. While the trouble has been observed in several varieties of apples, the Jonathan is especially susceptible, hence the name "Jonathan Breakdown". Reliable information secured from shippers indicates that during the eight-year period, 1922 to 1929, British Columbia apple growers suffered a direct loss of over $400,000 in rebates for breakdown in the Jonathan variety. The indirect loss due to injured reputation was undoubtedly far greater.

Breakdown seldom develops until several weeks after the fruit has been picked. The injury is first evident as a light brown discolouration of the flesh and in this stage can only be detected by cutting the fruit. The diseased areas are indefinite in outline and usually originate in the region of the vascular bundles or near the skin. The core area and the flesh immediately adjacent to the stem are seldom injured. In the advanced stages of the disease, affected specimens can often be identified by the dull colour of the skin and soft texture of the fruit. In many cases the injury is intensified by the action of fungi which gain entrance through the weakened skin, but as no bacteria nor fungi have been found associated with the early stages of the disease it is considered to be physiological in character.

Investigation of the breakdown problem was begun at the Summerland Experimental Station in 1923. At that time somewhat similar injury had already been reported in apples from the United States, England, and New Zealand, by Ballard (*1*), Brooks (*2*), Powell (*11*), Ramsey (*12*), Stubenrauch (*13*), Winkler (*15*), Kidd (*5*) (*6*), Waters (*14*) and their co-workers. Without reviewing in detail the individual contributions of these investigators it may be stated that a study of their publications, together with information secured from local fruit growers and shippers, indicated that the development of Jonathan breakdown might be influenced by three distinct sets of conditions, namely: environment in the orchard, maturity of the fruit when harvested, and storage treatment. Accordingly a series of experiments was planned to ascertain what particular conditions were responsible for the prevalence of breakdown in British Columbia Jonathans, and whether by modification of these conditions the heavy losses occasioned by this disease could be prevented.

A report of some experiments carried out coöperatively by the Horticultural Division of the Central Experimental Farm, the Fruit Branch of the Dominion Department of Agriculture, and the Summerland Experimental Station has been published by Daly (*3*). The results of another coöperative

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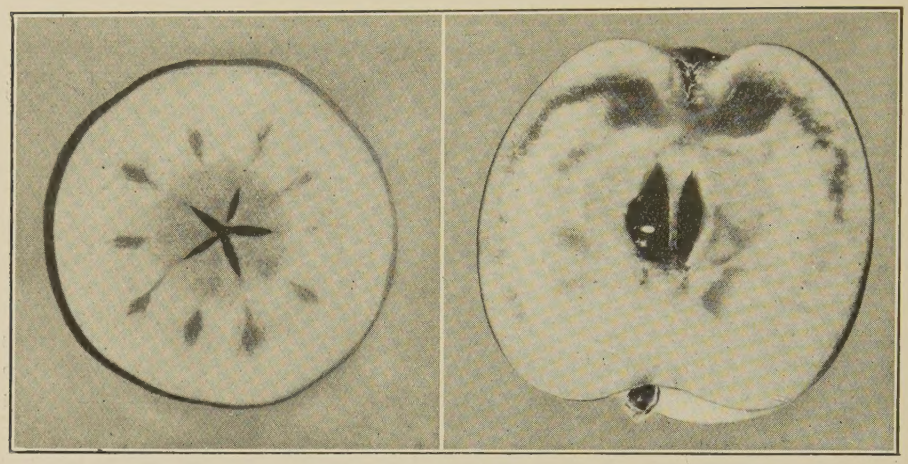

Figure 1. Water-core in the Jonathan Apple.

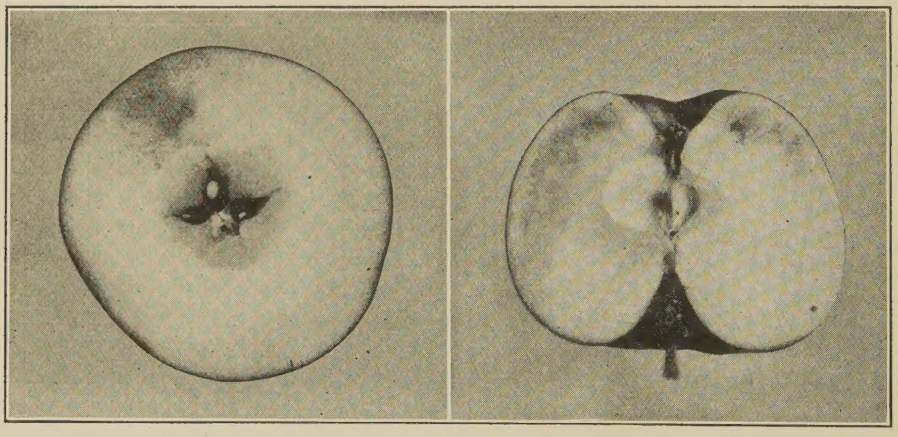

Figure 2. Breakdown in the Jonathan Apple—Early Stage.

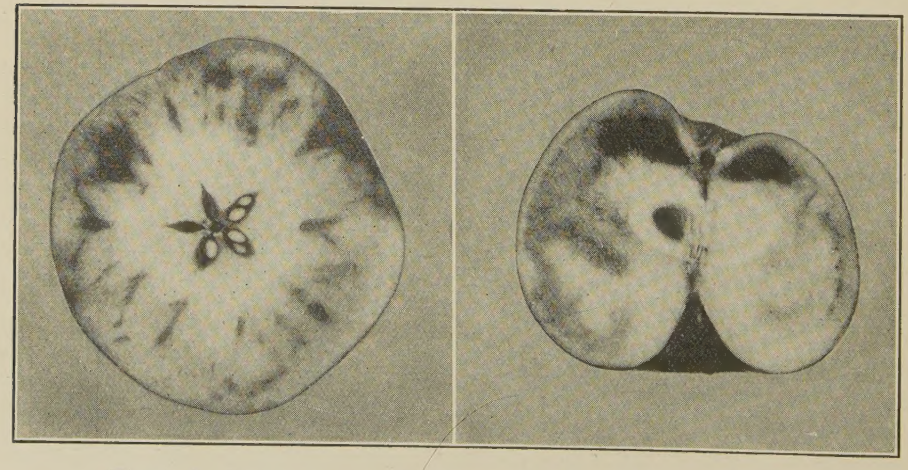

Figure 3. Breakdown in the Jonathan Apple—Advanced Stage.

project involving shipment of Jonathan apples from Summerland to England have been reported in detail by the Empire Marketing Board (*4*). Statements regarding the progress of the work at Summerland have been published in the annual reports of the Summerland Experimental Station (*9*) and in the annual reports of the British Columbia Fruit Growers' Association (*10*). These reports have been written in popular form for the benefit of fruit growers. Practical control measures have been suggested but very little mention has been made of the experimental data on which these recommendations are based. A comprehensive bulletin is now in preparation embodying a wealth of experimental evidence which has been accumulated during the past seven years. In the meantime, this paper has been prepared in order to acquaint other investigators with some of the more important results which have been secured. For the sake of brevity, no attempt is made to discuss the work of contemporary investigators. Suffice it to say that injuries which are somewhat similar in appearance to Jonathan breakdown have been reported in England, the United States, New Zealand and Australia under the names: internal breakdown, physiological breakdown, inherent breakdown, low temperature breakdown, soggy breakdown, flesh collapse, sleepiness, internal browning, brown heart, and freezing injury. There is ample evidence that these injuries are not all due to the same cause, nor amenable to the same control measures. Nevertheless, there are good grounds for believing that the Jonathan type of breakdown is not entirely confined to apples from western Canada. Accordingly, this paper is presented in the hope that the information contained therein may prove of practical value to other investigators in their efforts to prevent the heavy losses caused by breakdown in the Jonathan. All data furnished are the result of experiments carried out with the Jonathan variety.

Influence of Orchard Environment on Breakdown

During the past seven years extensive experiments have been carried on to ascertain the extent to which breakdown is influenced by conditions in the orchard. Records have been secured of the amount of breakdown occurring in apples from more than three hundred individual trees growing in commercial orchards in the Salmon Arm, Vernon, Oyama, Okanagan Centre, Kelowna, Summerland, Penticton and Keremeos districts. These trees were selected so as to provide as wide a range as possible of climatic, soil, cultural, irrigation, pruning and thinning conditions as well as age and vigour of tree.

The results secured indicate that losses from breakdown are much more serious some seasons than others. There is some evidence that heavy rains towards the close of the growing season render apples more susceptible to this disease. Losses from breakdown were exceptionally heavy in 1922 and in 1927. The meterological records kept at the Summerland Experimental Station show that the rainfall during August and September was 2.59 inches in 1922 and 3.54 inches in 1927. The average rainfall for these two months over an eight-year period was 1.57 inches. There were comparatively few claims for rebates on account of breakdown in 1925 and 1928. The rainfall recorded for August and September in these two years was .71 and .24 inches respectively. Breakdown is more prevalent in apples from

some districts than from others and there is ample evidence that apples grown on heavy soils retentive of moisture are more subject to the trouble than are apples grown on light soils which tend to dry out towards the latter end of the season. Breakdown is not confined to fruit grown on irrigated land but application of large amounts of irrigation water near harvest time has been found to favour development of the disease.

Attempts to overcome susceptibility to breakdown by fertilizer treatment have given discouraging results. Severe pruning of the trees and heavy thinning of the fruit have been conducive to the disease. There is evidence that fruit from trees top-grafted on a vigorous stock is especially liable to develop breakdown. In fact, any orchard practice or cultural treatment which promotes very vigorous growth of tree and fruit seems to increase the susceptibility of the apples to the disease. It appears probable that the amount of leaf surface per apple is of paramount importance in determining susceptibility to breakdown. There is overwhelming evidence that fruit from trees carrying a light crop is much more likely to develop breakdown than that from trees which are heavily laden. Data substantiating this statement are presented in table 1.

TABLE 1. *Amount of crop and breakdown.*

Tree Number	Yield in 1929 expressed as percentage of 5-year average	Percentage of apples which developed breakdown in 1929
485	260	22
476	225	0
483	174	0
72	165	10
474	150	5
475	146	27
71	146	5
481	146	0
482	132	0
472	130	3
84	127	5
477	107	0
471	88	41
470	83	34
69	78	69
73	70	81
81	47	60
478	41	67
68	33	42
70	28	75
77	24	61
79	23	59
473	19	2
76	17	37
74	17	63

The data incorporated in table 1 were secured by harvesting the crop from twenty-five trees on October 28th, 1929. Out of the crop from each individual tree, one hundred apples between 2½ and 3 inches in diameter and carrying from 15 to 40 per cent red colour were selected. These apples were held in common storage and examined on January 12th, 1930. Each apple was cut to ascertain whether or not breakdown was present. In table 1, the 1929 yield of each tree is expressed in percentage of the average

yield for the previous five years. It will be noted that of the 25 trees, 12 carried more than an average crop and 13 carried less than an average crop. With one exception the fruit from trees carrying less than an average crop developed much more breakdown than did that from trees carrying more than an average crop. Additional data supporting the contention that the fruit from light crop trees is more subject to the disease than that from trees which are heavily laden appears in tables 2, 3, 8, and 12.

Influence of Condition of Fruit at Picking Time on Beakdown

Each year harvesting experiments have been carried out with 20 or more trees. From each of these trees about 30 apples have been picked each week for a period beginning before and extending well beyond the customary harvesting season. At each picking date careful observations have been made of the maturity of the apples from each tree as indicated by seed colour, hardness, water-core, and colour of the skin on the unblushed side of the fruit. Immediately after picking, the apples have been placed in a common storage cellar. After several months the amount of breakdown in each picking has been ascertained by cutting the fruit. In order to determine the influence of picking date on grade and yield, measurements of colour and size have been made each week on several hundred apples which were left on the trees throughout the harvesting period. Information regarding the relation between size and breakdown, and red colour and breakdown, has been secured by grading the entire crop from 10 trees into various size and colour classes, the breakdown in each class being determined after several months' storage.

The important influence of picking date on breakdown is illustrated by the data presented in table 2.

Table 2.—*Picking date and breakdown 1929.*

Tree Number	Amount of crop	Percentage of breakdown apples from each picking date						
		Sept. 15	Sept. 23	Sept. 30	Oct. 7	Oct. 14	Oct. 21	Oct. 28
7	light	0	10	20	35	55	60	85
8	light	0	15	15	10	40	55	75
11	light	0	0	35	85	90	95	100
18	light	0	0	20	90	90	95	90
3	medium	0	0	30	70	70	70	100
4	medium	0	0	5	45	10	70	40
5	medium	0	0	15	75	75	80	90
1	heavy	0	0	0	0	0	0	5
2	heavy	0	0	0	0	0	0	0
6	heavy	0	0	0	0	0	25	80
9	heavy	0	0	0	0	0	0	5
10	heavy	0	0	0	0	0	0	0
13	heavy	0	0	0	0	0	20	40
14	heavy	0	0	0	0	5	25	70
15	heavy	0	0	0	0	0	40	90
16	heavy	0	0	0	0	0	10	70
12A	light	0	5	5	95	65	100	100
12B	heavy	0	0	0	0	20	75	95
17A	light	0	0	0	35	0	75	80
17B	heavy	0	0	0	0	0	0	90

The above data were secured from picking tests made on 18 trees in the Penticton district in 1929. Twenty apples were picked from each tree at each picking date and the percentage of these apples which developed breakdown determined by cutting them on January 12th, 1930. The number of apples picked from each tree on each picking date was comparatively small but the remarkable consistency of the results secured with the individual trees leaves no doubt as to the significance of the data. In table 2 the trees have been classified into three groups: those carrying a light or less than average crop, those with a medium or average crop, and those with a heavy or above average crop. It will be noted that no breakdown developed in any of the apples picked on September 15th. In the September 23rd picking a small percentage of the apples from several light crop trees developed breakdown. In almost every case the percentage of breakdown apples increased with each week that picking was delayed. It is worthy of note that apples from a few of the heavy crop trees showed practically no breakdown even when picked as late as October 28th. Special attention is drawn to the results recorded with apples from trees 12 and 17. On these trees some of the branches carried a light crop and some a heavy crop. The fruit from these branches was harvested separately and it will be noted that the apples from the lightly laden branches behaved like those from light crop trees whereas the apples from the heavily laden branches showed very little breakdown except in those pickings made late in the season.

Data very similar to that presented in table 2 have been recorded each year since this investigation was started. Evidence substantiating this statement is to be found in table 3.

TABLE 3.—*Picking date and breakdown 1923-1929.*

Year	Percentage light crop trees	Percentage breakdown apples from each picking						
		first	second	third	fourth	fifth	sixth	seventh
1923	15	0	0	0	0	1.9	13.5	21.8
1924	20	0	.5	1.1	7.4	11.4	17.4	19.6
1925	45	0	1.0	4.8	21.2	36.0	57.0	64.3
1926	10	0	0	.7	2.2	4.8	5.5	7.2
1927	30	0	0	2.2	17.0	31.8	35.0	45.0
1928	20	0	0	4.0	14.5	26.5	41.0	39.0
1929	30	0	1.5	7.2	27.0	26.0	44.2	65.5

Each figure in table 3 represents the percentage of breakdown recorded in 200 apples picked from 20 trees. With a few exceptions the same trees were used each year, the first picking being made about September 15th and subsequent pickings at weekly intervals till the end of October. It will be noted that each year the percentage of breakdown apples increased with each week that picking was delayed. It is also worthy of note that breakdown was especially serious in 1925, 1927 and 1929 when a fairly large percentage of the trees in the experiment carried a light crop. In 1926 when a very small percentage of the trees carried a light crop the percentage of breakdown was also very small.

The data presented in tables 2 and 3 suggest that breakdown could be entirely prevented by harvesting all Jonathans before September 15th. Such a procedure is impractical, however, owing to the fact that it would result in serious reduction of yield and grade. Evidence bearing on this statement is presented in table 4.

TABLE 4.—*Picking date and yield.*

Picking Date	Sept. 15	Sept. 23	Sept. 30	Oct. 8	Oct. 14	Oct. 21
Average diameter of apples in inches	2.47	2.55	2.58	2.64	2.67	2.71
Percentage increase in volume	..	11	16	22	28	31
Percentage apples over 2½ inches	51	66	71	78	82	85
Percentage loss from windfalls	..	..	..	..	1	7

The data set forth in the above table were secured by making diameter measurements on 180 apples each week during the harvest season of 1929. Ten of these apples were located on each of the trees mentioned in table 2 and they were selected to provide a range of sizes typical of the crop as a whole. Each apple was labeled with a metal tag and was calipered to the nearest 32nd of an inch each week. From the data presented in table 4 it is apparent that the apples continued to increase in size until quite late in the season. The effect of this increase in diameter on yield is evidenced by the figures representing percentage increase in volume. These figures have been calculated on the basis of the relation of the volume of a sphere to its diameter. While apples are not perfectly spherical their volumes undoubtedly bear a very similar relation to their diameters. The percentage of apples over 2½ inches in diameter at each picking date is also shown. The importance of this information lies in the fact that the most desirable sizes of the Jonathan are between 2½ and 3 inches in diameter. The percentage of windfalls has an important bearing on yield as it has been found that after the middle of October the loss from this cause often exceeds the gain from growth. By October 28th about 20 per cent of the apples in the above experiment had been blown from the trees.

The increase in red colour from week to week is well shown in table 5.

TABLE 5.—*Picking date and grade.*

Picking Date	Sept. 15	Sept. 23	Sept. 30	Oct. 7	Oct. 14	Oct. 21
Percentage Red Colour	7	16	39	66	70	73
Percentage apples 15% red	19	35	70	90	95	95
Percentage apples 40% red	4	17	45	75	83	85

The above information was obtained by recording the amount of red colour on 180 apples each week. It will be noted that there was a particularly rapid increase in red colour development between September 23rd and October 7th. In Canada the colour requirement for Fancy Jonathan is

15 per cent solid red, and for Extra Fancy Jonathan, is 40 per cent solid red. Table 5 shows the percentage of these grades each week. It will be noted that a high percentage of the apples had sufficient colour to qualify for the Fancy grade by October 7th, but that a great deal of low quality fruit would have resulted if the whole crop had been picked by September 23rd.

The fact that large size is conducive to breakdown is evidenced by the data incorporated in table 6.

TABLE 6.—*Size and breakdown.*

Tree Number	Diameter of apples and percentage of breakdown		
	Over 3 inches	2½ to 3 inches	under 2½ inches
F4	91	81	37
H4	87	77	51
H6	74	61	36
K6	69	28	12
O2	88	65	45
O4	40	18	9
Q2	95	86	62
S12	100	92	71
U4	47	14	18
U10	86	62	43

In the experiment reported in table 6 the crop from 10 trees was harvested on October 22nd, 1929. Out of the crop from each tree 100 apples were selected with a diameter over 3 inches, another 100 with a diameter of 2½ to 3 inches, and a third 100 below 2½ inches in diameter. All apples selected carried from 15 to 40 per cent red colour. These apples were stored until January 15th, 1930, on which date they were cut to determine the percentage of breakdown which had developed. From the results secured it is evident that even with apples picked from the same tree on the same date the large sizes were more subject to breakdown than the medium or small sizes.

In a similar manner the relation of red colour to breakdown has been ascertained by grading fruit of uniform size from 10 individual trees into classes with more than 40 per cent red, 15 to 40 per cent red, and under 15 per cent red colour. Data obtained by this procedure are to be found in table 7.

TABLE 7.—*Red colour and breakdown.*

Tree Number	Percentage of red colour and percentage of breakdown		
	Over 40% red	15% to 40% red	under 15% red
F4	89	90	65
H4	85	77	52
H6	81	58	32
K6	54	29	5
O2	76	66	56
O4	36	19	20
Q2	82	88	72
S12	90	91	67
U4	39	16	5
U10	80	59	56

The data shown in table 7 indicate that susceptibility to breakdown is correlated with the amount of red colour even in fruit picked from the same tree on the same date.

It seems probable that the relation of red colour to breakdown is largely a matter of maturity. Various changes in the apple have been recorded at each harvest date in an endeavour to find a simple maturity index which would make it possible to harvest Jonathans early enough to prevent breakdown and yet allow sufficient time for satisfactory development of size and grade. Seed colour has not proved reliable as a maturity test. Hardness of the fruit, as measured by the mechanical pressure tester devised by Magness (*7*), has been found of only limited value as a guide to picking maturity in the Jonathan. The development of red colour is not an altogether satisfactory maturity test, for other evidences of maturity indicate that poorly coloured apples on light crop trees are often more mature than highly coloured fruit on trees carrying a full crop. Change in the colour of the skin on the unblushed side of the fruit, however, has proved to be a fairly dependable maturity index. As the Jonathan apple nears maturity on the tree, the skin on the unblushed side of the fruit changes gradually from a leaf green to a clear yellow.

In 1925 a copy of a colour chart devised by Magness (*8*) was secured. It was made up of four colour plates numbered consecutively from 1 to 4 and ranging from leaf green to a clear yellow. This chart is now used as a standard in apple and pear harvesting investigations in the United States. It was found by experiment that in all cases the skin colour on Jonathan had progressed beyond stage 1 shown on the United States chart at the time picking was started. With this fact in mind colour plate 1 on the United States chart has been omitted from the chart used at this station, with the result that colours 2, 3, and 4 on the United States chart are represented by the figures 1, 2 and 3 respectively on the chart used in this investigation. This has made it possible to prepare a simple chart of a size which can be conveniently carried in the pocket or mailed in a business envelope. Comparatively slight differences in colour can be recorded with this chart. For instance a colour stage intermediate between colour plates 1 and 2 may be designated 1½. Some of the data secured with the colour chart in 1929 are presented in table 8.

It will be noted that with the exception of a few specimens from two light crop trees no apples picked before they had reached colour stage 3 developed breakdown. These two light crop trees are large and vigorous and in their heavy crop year carry over 20 boxes of apples each. In 1929 their combined crop totalled less than 5 boxes. It will be noted that the fruit from several of the heavy crop trees developed practically no breakdown even though picked when the skin colour had reached stage 3.

The development of water-core has also been found to have value as a maturity test. In the Jonathan variety, water-core usually appears first as small water-soaked areas in the region of the vascular bundles. When the apple is cut across, these water-soaked areas appear as spots arranged in a circle around the core. In apples which are left on the tree till late in the season these spots increase in size until they eventually form a com-

TABLE 8.—*Maturity and breakdown.*

Tree Number	Amount of crop	Colour stage and percentage of breakdown				
		1	1½	2	2½	3
7	light	0	0	20	35	65
8	light	0	0	15	25	45
11	light	0	0	0	0	65
18	light	0	0	0	0	75
3	medium	0	0	0	0	65
4	medium	0	0	0	0	35
5	medium	0	0	0	0	65
1	heavy	0	0	0	0	1.5
2	heavy	0	0	0	0	0
6	heavy	0	0	0	0	5
9	heavy	0	0	0	0	2.5
10	heavy	0	0	0	0	0
13	heavy	0	0	0	0	20
14	heavy	0	0	0	0	25
15	heavy	0	0	0	0	20
16	heavy	0	0	0	0	20
12A	light	0	0	0	0	60
12B	heavy	0	0	0	0	45
17A	light	0	0	0	0	35
17B	heavy	0	0	0	0	15

plete band of water-soaked tissue. In recording the amount of water-core the first appearance of the spots has been designated as "slight". When the water-soaked areas have assumed the form of a continuous band, the degree of development has been noted as "excessive". The word "moderate" has been used to denote an amount of water-core intermediate between "slight" and "excessive". The correlation between water-core and breakdown is indicated in table 9.

TABLE 9.—*Water-core and breakdown.*

Tree Number	Percentage of apples affected by water-core			Percentage apples which developed breakdown
	Slight	Moderate	Excessive	
27	0	0	0	0
25	1	0	0	0
28	2	0	0	0
26	12	12	0	9
29	36	15	0	8
21	25	10	4	5
20	10	27	6	31
22	42	12	9	30
24	11	10	13	2
23	4	24	72	58

The above data were secured by selecting 200 apples 2½ to 3 inches in diameter and carrying from 15 to 40 per cent red colour, from the crop of each of 10 trees harvested on October 28th, 1929. One hundred apples from each tree were cut immediately after harvest and the amount of water-core determined. The other 100 apples from each tree were placed in storage and the number which developed breakdown was ascertained by a cutting

test made in February 1930. It is evident that water-core is frequently followed by breakdown. It is also apparent, however, that apples which show water-core at harvest time, even in excessive amounts, do not always develop breakdown. On the other hand, there is strong evidence that breakdown seldom, if ever, develops in Jonathans which do not show water-core at harvest time. These observations, together with the fact that breakdown frequently develops in the same areas of the flesh which are affected by water-core, suggest that these two troubles are very intimately related.

Influence of Storage Treatments on Breakdown

More than a thousand boxes of apples have been used in experiments to ascertain the influence of storage conditions on the development of Jonathan breakdown. Some evidence has been secured which indicates that the humidity of the atmosphere in the storage chamber may have a significant influence on the development of the disease. Table 10 provides an example of the data which have been recorded.

Table 10.—*Storage humidity and breakdown.*

Lot No.	Storage Treatment	Percentage Breakdown
1	Unwrapped—Relative humidity 60-75%	13
2	Unwrapped—Relative humidity 80-90%	18.2
3	Plain wraps—Relative humidity 80-90%	17.7
4	Oiled wraps—Relative humidity 80-90%	26

In securing the above data 1200 apples picked on October 12th, 1926, were divided into four lots of 300 apples each. Care was taken to see that each lot was comparable as regards size and colour development. Lot 1 was then placed unwrapped in a common storage cellar in which the relative humidity was maintained at between 60 and 75 per cent. Lot 2 was placed in a similar cellar in which the humidity was increased to from 80 to 90 per cent by applying water on the floor. Lot 3 was placed in the 80 to 90 humidity cellar but was wrapped in plain tissue paper. Lot 4 received similar treatment to lot 3 with the exception that oiled wrappers were used. All lots were examined in March 1927 and the amount of breakdown ascertained. The results recorded suggest that high relative humidity is conducive to breakdown. Low relative humidity in the storage atmosphere favours the development of shrivelling and often results in loss of that crisp, juicy texture which makes the Jonathan so appetizing. Accordingly, it seems doubtful whether humidity control will prove desirable as a method of reducing losses from breakdown.

With regard to storage temperature a great deal of evidence has been secured to the effect that the development of the disease can be delayed but not prevented by maintaining low temperatures in the storage chamber. The type of data obtained is exemplified in table 11.

This table sets forth the result of an experiment in which 400 apples picked on October 14th, 1926, were immediately placed in cold storage. A comparable lot of fruit picked from the same trees on the same date was

TABLE 11.—*Storage temperature and breakdown.*

Lot No.	Storage Treatment	Percentage breakdown at each examination date			
		Nov. 15	Dec. 18	Jan. 18	Feb. 20
1	Cold storage 32° F.	6	17	28	37
2	Common storage 60°-35° F.	29	32	35	34

placed in a common storage cellar where the temperature ranged from 60°F. during October to 35°F. in December and January. In both storages a relative humidity of over 80 per cent was maintained. The fruit was examined at monthly intervals, and at each examination 100 apples in each storage were cut to determine the percentage of breakdown which had developed. From the data obtained it is evident that the ultimate amount of breakdown was not greatly influenced by the two storage treatments but the disease developed much more rapidly in the common storage chamber.

CONTROL MEASURES FOR JONATHAN BREAKDOWN

The most important results reported in the foregoing paragraphs, from the standpoint of practical control of breakdown, may be very briefly summarized as follows:

(1) Susceptibility of Jonathan apples to breakdown is increased by an orchard environment which promotes very vigorous growth.

(2) Breakdown can be prevented by picking the apples at the proper stage of maturity.

(3) Change in colour of the skin on the unblushed side of the fruit is a fairly reliable maturity index.

(4) Trees carrying a light crop should be picked earlier than those which are heavily laden.

(5) The development of breakdown can be delayed but not prevented by storage at low temperatures.

In an attempt to apply this information to commercial control of the disease the inadvisability of over-fertilization, severe pruning, heavy thinning and late irrigation have been brought to the attention of growers. Harvesting of the Jonathan at the proper stage of maturity has been facilitated by free distribution of maturity colour charts. Each chart is made up of three colour plates and carries a legend indicating the most desirable colour stage at which to harvest the Jonathan. The following instructions have been sent out with the charts:

> "This colour chart is based on the fact that, as an apple nears maturity on the tree, the colour of the skin on the unblushed side of the fruit changes gradually from leaf green to clear yellow. In using the chart representative apples should be placed behind the holes cut in the colour plates. In this way it is possible to compare the colour of the apples with the colours on the chart. This colour comparison should be made in daylight in the shade. It usually takes the Jonathan about two weeks to pass from one colour stage to the next. Jonathans

harvested before the colour has reached stage 2 are likely to be inferior in quality. The apples on lightly laden trees mature earlier than do those on trees carrying a full crop. Breakdown occurs very freely in over-mature fruit from trees carrying a light crop. Accordingly it is most important that the fruit from trees carrying a light crop should be picked as soon as it reaches stage 2 shown on the colour chart. Jonathans on heavily laden trees may safely be picked during the two weeks they are changing from stage 2 to stage 3."

The disadvantage of the colour chart method of control lies in the fact that it places the responsibility for time of harvesting on the individual grower. It has been found impossible to secure the coöperation of all growers. As the bulk of the crop is shipped through centralized packing houses, this means that those who pick according to the chart have to share the losses occasioned by other growers who insist on delaying their harvesting in order to secure a greater proportion of Extra Fancy grade fruit.

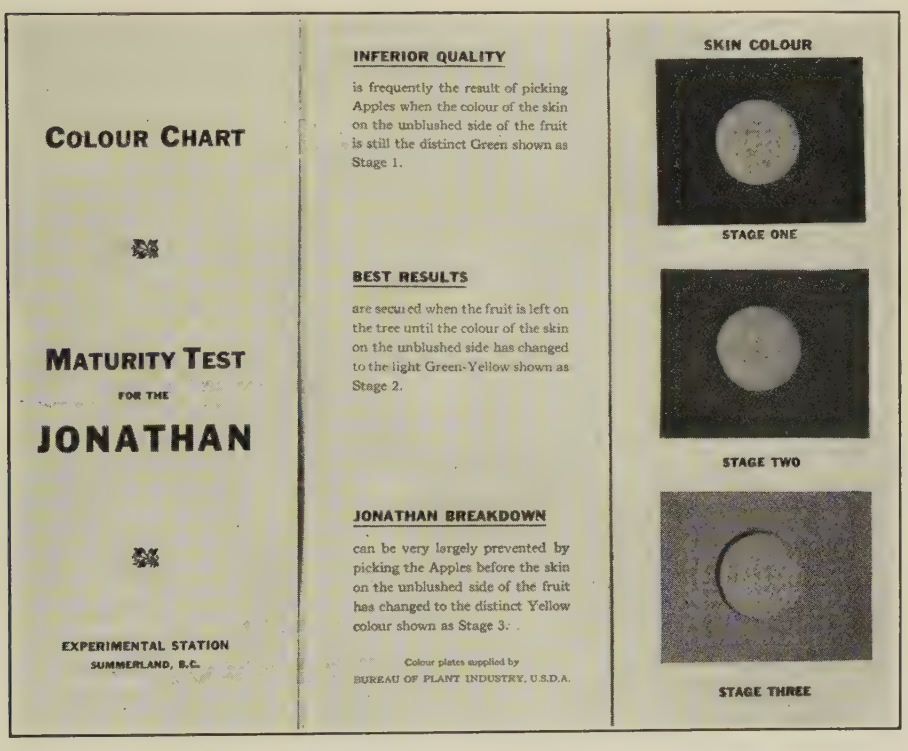

Figure 4. Facsimile of Maturity Colour Chart.

In an attempt to put all growers on the same footing several shipping organizations have tried setting a calendar date before which the Jonathans produced by their growers should be harvested. Separate pools have been established for apples picked after the dates specified. In this way it was hoped to make growers who delayed harvesting their Jonathans bear any direct loss from breakdown occasioned by this late picking. The weakness of the picking date pool scheme lies in the fact that when the date was set

early enough to prevent breakdown in the fruit from light crop trees, a great many of the apples from heavily laden trees were picked before they had reached satisfactory maturity. When the picking date was set late enough to ensure good quality and high colour development in the fruit from heavy crop trees a good deal of breakdown occurred in the fruit picked from trees which were carrying a light crop.

In 1929 an attempt was made to devise a harvesting programme which would combine the desirable features of the colour chart and picking date pool schemes without the disadvantages of these methods of control. The details of this harvesting plan are set forth in the following circular which was sent by the Directors of the Penticton Coöperative Growers Association to each of their members.

PENTICTON COOPERATIVE GROWERS
PROPOSAL FOR HANDLING THE 1929 JONATHAN CROP

With a view to reducing the losses from breakdown of the Jonathan apple, your Board of Directors have been in consultation with R. C. Palmer of the Summerland Experimental Station.

A harvesting plan has been devised which it is believed will, if carefully carried out, result in a material reduction in claims for breakdown and at the same time ensure the shipment of a large percentage of high grade fruit.

This harvesting plan is based on the fact that experiments conducted over a six-year period have shown that most of the breakdown occurs in over-mature fruit picked from trees carrying a LIGHT CROP. The fruit on LIGHTLY LADEN trees matures earlier than does that on trees carrying a full crop.

Accordingly, it is proposed to have the Fieldman, with necessary assistants and with the help of the grower, inspect all the Jonathan trees from which fruit is shipped through the Penticton Local. Trees having less than 50 per cent of a crop will be tagged in a conspicuous manner.

After making a careful survey of the maturity of the Jonathan crop in the district as a whole, Mr. Palmer will set a date when these LIGHT CROP TREES should be picked. Immediately after this date a check-up will be made and if any orchards are found in which the LIGHT CROP TREES are still unpicked, the undelivered portion of the crop from those orchards will be segregated so that any claims for breakdown on these apples can be charged back directly to the delinquent growers as a group.

Breakdown occurs in the fruit from HEAVILY LADEN TREES if harvesting is delayed until very late in the season. Accordingly it will also be necessary to set a date when the crop from the HEAVILY LADEN TREES should be picked. This date will, however, be fully two weeks later than the date for the light crop trees, thus allowing for full development of red colour on the main crop. Any fruit picked after this second date will be segregated so that claims for breakdown can be charged back to the growers concerned.

The procedure as outlined above will involve the expenditure of a limited sum of money and it is proposed to charge this sum on a per box basis directly to the Jonathan growers.

In view of the fact that the Jonathan apple has not realized the cost of production for a number of years now, owing largely to the prevalence of breakdown, your directors feel that this expense will be more than offset, if, through this plan, the Jonathan variety can again be brought back to a position in the desirable group of apples which net the grower some degree of profit.

The full support and coöperation of all growers of Jonathan apples will be required to make a success of this proposal and it is hoped that it will receive the unanimous approval of all concerned.

Penticton, B.C., August 23rd, 1929.

Losses from breakdown during the past seven years have not been as serious in Penticton Jonathans as has been the case with the apples from several other districts. However, the growers in the Penticton district are sufficiently far-sighted to realize the magnitude of the indirect loss which

they have suffered from the disastrous effect which Jonathan breakdown has had on the reputation of British Columbia apples. Accordingly, it was not difficult to persuade them to undertake the harvesting programme outlined above, even though this procedure was estimated to entail a cost of about one cent for every box of Jonathans handled. Accordingly the plan was carried out in 1929. Over 12,000 trees were examined and of these, 4065 were placed in the light crop class. The harvesting dates set were September 25th for light crop trees and October 10th for heavy crop trees. Practically the entire crop was picked on schedule. The success of this harvesting programme is indicated by the data presented in table 12.

TABLE 12.—*Rebates for breakdown.*
Penticton Cooperative Growers.

Year	Boxes shipped	Rebates—dollars	Deductions per box—cents
1924	26,689	1,468	5.5
1925	74,452	684	1
1926	68,802	1,297	2
1927	58,745	2,314	4
1928	72,362	685	1
1929	64,800	0	.8

Table 12 shows the total number of boxes of Jonathans shipped by the Penticton Coöperative Growers each year from 1924 to 1929. This table also includes figures showing the amount of rebates which have been allowed each year on account of breakdown and the deductions which it has been necessary to make from growers' returns in consequence. It will be noted that it was not necessary to allow any rebates for Jonathan breakdown in 1929. However, a deduction of four-fifths of a cent per box was made to cover cost of tagging trees, etc.

The total freedom from claims for rebates on Penticton Jonathans in 1929 may be due in part to the marketing policy adopted by the Associated Growers, the sales agency which disposed of the crop. The Associated Growers placed large sized Jonathans on the market as rapidly as possible. In this way a good deal of fruit which might have developed breakdown was moved into consumption before the disease had time to appear. In carrying out this policy the Associated Growers were undoubtedly aided by the fact that the Penticton Coöperative Growers have recently installed refrigerating equipment which makes it possible to cool their apples to a low temperature very shortly after they are harvested.

Nevertheless, it is obviously safer to control breakdown by preventing the fruit from becoming susceptible to the disease rather than by attempting to get it eaten before the injury develops. The only real difficulty experienced in putting the above harvesting plan into effect was the classifying of trees carrying about half a crop. From the data presented in table 2 it is evident that the apples from such trees are almost as susceptible to breakdown as those from light crop trees. Accordingly in their 1930 picking programme the Penticton Coöperative Growers have decided to follow the same plan as in 1929 with the exception that all trees carrying less than 60 per cent of a full crop will be placed in the light crop class and harvested accordingly.

It is worthy of note that the data embodied in table 12 indicate that claims for rebates on account of breakdown were heaviest in 1924 and 1927 when total shipments were comparatively light. Conversely, in the heavy crop years, 1925 and 1928, losses from breakdown were comparatively small.

From the data presented in this paper it is apparent that a good deal has been learned regarding the influence of cultural, harvesting and storage conditions on the development of Jonathan breakdown. Furthermore, there is evidence that real progress has been made in devising practical control measures designed to prevent repetition of the disastrous losses which have occurred in the past. On the other hand, the information which has been secured only serves to emphasize the urgent need for more fundamental research to ascertain the primary cause of the disease.

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THE USE OF HONEY IN WATER-ICES AND SHERBETS

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[Received for publication, November 6, 1930]

The last few years have witnessed somewhat of a revival of interest in the manufacture of water-ices and sherbets by both the ice cream manufacturer and the investigator. Dahlberg (*1*) in 1926 published the results of extensive research work on the hardness, drainage of syrup, and crust formation in water-ices and sherbets, and more recently (*2*) has published some additional information gained through experiments since that time. Masurovsky (*3*) has written a series of short articles on the manufacture of these products. Caulfield and Martin (*4*) have published the results of experimental work conducted at Kansas State College.

The composition of water-ice and sherbet mixtures and methods of processing have not been brought to the same degree of standardization that has ice cream, but the information that has been published recently has done much to put the manufacture of these products on a more scientific basis.

One of the defects that has given the manufacturer considerable trouble is the hard spots that will form on the exposed surface of the product. This crust formation is the result of crystallization of the sucrose which is unstable in the highly concentrated solutions in water-ices and sherbets. Dahlberg (*1*) was able to almost entirely prevent the development of these spots by substituting a portion of the sucrose with corn sugar. He also states that invert sugar might have been used in place of the corn sugar with equally good results.

Those familiar with the Canadian standards for ice cream know that corn sugar is not permitted in its manufacture. Many manufacturers have hesitated to use corn sugar in water-ices and sherbets thinking that its use would be illegal. As water-ices and sherbets are not mentioned or included in the ice cream regulations, the use of corn sugar is permissible.

The fact that invert sugars might replace dextrose to prevent sugar crystallization gave the writer the idea of using honey in place of dextrose. Honey, according to Browne's (*5*) analysis is composed of the following: water 17.59 per cent, invert sugar 74.41 per cent, sucrose 1.98 per cent, ash .23 per cent, dextrin 2.09 per cent, undetermined 3.77 per cent. Since honey contains approximately 75 per cent invert sugar on the average it should, therefore, prove satisfactory in preventing the formation of crusted areas on water-ices and sherbets.

It was with the object of studying the possibilities of using honey in these products that certain experimental work was undertaken, the results of which are reported in this article.

PLAN OF WORK

At the outset it was planned to study the problem from the following angles:

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1. Effect of honey on crystallization of the sucrose.
2. Desirable percentage of honey to use.
3. Grade of honey that could be used.
4. Effect of using honey on the cost of the mixture.

Since the work was started one or two other points have come up and have also been investigated.

The honey for the experimental batches was partly furnished by the Apiculture Department of the Ontario Agricultural College, and partly by the Ontario Honey Producers' Coöperative Ltd., of Toronto.

There are no legal standards or grades for honey in Canada, but the grades adopted by the Ontario Honey Producers' Coöperative are more or less generally used. These grades are water white, white, golden, light amber, amber, and dark. The grades used in the United States are water white, extra white, white, extra light amber, light amber, amber, and dark. The water white and extra white grades of the U. S. cover practically the same range of color as the water white of Ontario, the whites of both standards are very similar, the extra light amber is equivalent, or nearly so, to the golden, and the remaining grades of both standards are quite similar. It was deemed inadvisable to use any honey lower than the light amber grade in the work on account of the strong flavor of the darker honeys.

Methods

A control batch of water-ice with sucrose as the sole sweetening agent was frozen along with every set of comparisons. In the early work a combination of agar and gelatin was used as a stabilizer, but later agar was omitted and gelatin was used alone.

Five pound batches were prepared in every case and frozen in a one gallon freezer with a belt drive.

All series of experiments, with one exception, were flavored with orange. Samples were saved in sanitary seal type tins of 16 ounce capacity and the covers left off, and were stored in the hardening room at temperatures ranging from minus 10°F. to 15°F. The samples were examined daily until crystal formation started, and thereafter two or three times a week.

Effect of Honey on Crystallization of the Sucrose

In the first series of experiments the control formula used was composed of 30 per cent sucrose, agar, gelatin, flavor, citric acid, color and water to make up the five pounds. The batch in which honey was used carried 25 per cent sucrose and 7 per cent honey, the stabilizer, flavor, acid and color being the same as for the control and the weight made up to five pounds with water. Honey is approximately 76 per cent sugar so that in the honey mixes there would be approximately 30.3 per cent sugar. The comparative sweetness of honey and sucrose is not definitely established as honey has a rather piercing sweetness. Most authorities give honey a somewhat lower sweetening power than sucrose pound for pound, and it was felt that 7 lbs. of honey should replace 5 lbs. of sucrose satisfactorily.

The results of the first five comparisons are tabulated in table 1, showing the length of time the samples were in storage before crystallization of the sucrose became evident.

TABLE 1.—*Effect of substituting part of the sucrose with honey on the crystallization of sucrose in water-ices.*

All Sucrose		Sucrose and Honey	
Sample No.	Days in storage before first spot appeared.	Sample No.	Days in storage before first spot appeared.
1 C	5	1 A	28
2 C	4	2 A	7
3 C	8	3 A	None after 1 month
4 C	7	4 A	7
5 C	4	5 A	None after 22 days

The figures in table 1 show that in nearly all cases the use of honey delayed the appearance of the spots. In these trials various means of inducing the crystal development were tried, such as heat shocking, cutting the surface with a knife, and sprinkling a few grains of sucrose on the surface. In the case of 2A very minute spots began to appear three days after sprinkling the sucrose on top. In all cases where spots did develop on the water-ices containing honey they were much softer.

After observing the results of these first five trials it was decided to run a second series with varying percentages of sucrose and honey, to determine just what combination would best prevent crystallization.

The control formula containing all sucrose was as follows:

Sucrose,	1.5 lbs. (30%)
Agar,	4.53 gms.
Gelatin,	4.53 gms.
Citric Acid (50% sol.)	15 c.c.
Orange Emulsion,	2 c.c.
Orange Color,	2 c.c.
Water to bring total weight to	5 lbs.

A control batch was frozen at the same time as each of the experiments. The quantity of flavor, acid, and color was the same for all batches in the series. The proportion of sucrose and honey used in the trials was as shown in table 2. Samples from each freezing were placed in storage and examined daily. Table 2 shows the results of these observations.

The results indicate, as would be expected, that as the proportion of honey to sucrose increased the tendency for the sucrose to crystallize is lessened. The various samples in this series were compared for flavor: 4 C was selected as the most desirable combination from the standpoint of freedom from crystallization, flavor and sweetness. Where honey was present the flavor lasted somewhat longer, with a slight after taste suggesting honey, which did not detract, however, from the general flavor. For the remaining experiments a combination of 22 per cent sucrose and 8 per cent honey was used.

TABLE 2.—*Effect of various proportions of honey and sucrose on crystallization of sucrose.*

No.	1 A. All sucrose	1 B. 25% sucrose 7% honey	1 C. 25% sucrose 8% honey	1 D. 25% sucrose 9% honey
Remarks	4 days first spot. 8 days, three large spots. 17 days, heavily crusted.	12 days, 4 small spots developing. 17 days, spots larger.	12 days, one small spot appearing. 17 days, few more small spots.	No spots showing after one month in storage.
No.	2 A. All sucrose.	2 B. 24% sucrose 7% honey.	2 C. 24% sucrose 8% honey.	2 D. 24% sucrose 9% honey.
Remarks	4days, spots showing. 14 days, heavily crusted.	16 days, three small soft spots.	No spots after 1 month in storage.	No spots after 1 month in storage
No.	3 A. All sucrose.	3 B. 23% sucrose 7 %honey	3 C. 23% sucrose 8% honey	3 D. 23% sucrose 9% honey
Remarks	5 days, one small spot. 10 days, several fairly large spots. 13 days, spots growing larger.	15 days, three small, soft spots, beginning to show	No spots after 1 month in storage.	No spots after 1 month in storage.
No.	4 A. All sucrose	4 B. 22% sucrose 7% honey	4 C. 22% sucrose 8% honey	4 D. 22 sucrose 9% honey
Remarks	12 days spots started to form.	No spots after 1 month in storage.	No spots after 1 month in storage.	No spots after 1 month in storage.

COMPARISON OF VARIOUS GRADES OF HONEY

Having established what proportions of honey and sugar combined best, four grades of honey were tried. Five batches of water-ice were made up using water white, white, golden and light amber honey to replace part of the sugar, and one batch contained no honey. These were examined for flavor, and it was the opinion of those making the examination that the mix containing the golden honey had the most desirable flavor. It blended very satisfactorily with the orange, and while the flavor was somewhat more lasting, a honey flavor was not distinguishable.

EFFECT OF DEXTROSE, AND HONEY, ON FLAVOR, CRYSTALLIZATION AND FREEZING POINT.

Three mixes were prepared, one containing 30 per cent sucrose, one 25 per cent sucrose and 7 per cent dextrose, and one 22 per cent sucrose and 8 per cent honey. These were frozen and placed in the hardening room for observation. The sample containing dextrose could not be distinguished from the all sucrose with respect to flavor. The one containing honey differed slightly in that the sweetness lasted longer but was in no way objectionable. The all sucrose sample showed spots at the end of thirteen days, the others failing to develop any after two months in storage.

A second series was prepared with one batch containing 33 per cent sucrose, one 26 per cent sucrose and 7 per cent dextrose, and one 27 per cent

sucrose and 8 per cent honey. The total sugar in the two latter cases was approximately 33 per cent. After eight days in storage the surface of each was scraped with a spoon to hasten crust formation. Crystal growth was evident on the all sucrose two days later, or at the tenth day, but did not appear on the others before the work was brought to a close. These results were expected, the presence of the invert sugars preventing the crystal formation. The flavor observations were similar to the first trial.

Freezing point determinations* were made with a Hortvet Cryoscope on the first three of the above mixes with the following results:

All sucrose	26.19°F.
Sucrose and honey	25.61°F.
Sucrose and dextrose	25.16°F.

The difference exhibited is not great enough to cause any difficulty in freezing, though it will require slightly more refrigeration and time.

Adaptability of Honey to Blend with Various Flavors

Previous experiments had shown that the honey could be satisfactorily used in an orange water-ice but there was a possibility that it might not blend so well with other flavors. In order to get some information on this point, batches of lemon, pineapple, grape, raspberry, strawberry and cherry water-ice were prepared, using honey to replace part of the sugar. The flavor of all these samples was satisfactory, indicating that the honey can be successfully used with various flavors.

Effect of Honey on Flavor of Sherbets

Water white, white, golden, and light amber grades of honey were incorporated in sherbet mixes, in which 50 per cent of the total weight was made up with whole milk. Control batches using water instead of milk were made for the sake of comparison. The proportion of 22 per cent sucrose and 8 per cent honey was used in all cases. The flavor of the samples conatining both milk and honey was not satisfactory. Golden honey was tried in a batch containing 10 per cent ice cream mix. The flavor of this sample was satisfactory.

Effect of Honey on Cost of Sweetening Agent for the Mix

In view of the fact that the golden grade of honey gave the most satisfactory results, with the exception of where milk was used in the mix, the price of the golden grade is used in this comparison. As the quantity of the other ingredients are not affected by the use of honey and as formulae for water-ices and sherbets vary quite widely, the sweetening agents only are taken into consideration. Anyone interested in using honey can substitute prices prevailing in their own locality. The cost prices of the various sweetening agents used were as follows:

Sucrose	4.8 cents a lb.
Cerelose (dextrose)	5.15 " " "
Golden honey	7.5 " " "

*Acknowledgement is made to Prof. A. L. Gibson, of the Chemistry Department, for the freezing point determinations.

The comparative cost of sweetening for a water-ice, or sherbet, where the proportions of these different sugars are as used in this work is given below:

TABLE 3.—*Figures based on 100 lbs. mix.*

Kind of sugar.	*Percentage used*	*Total cost*
Sucrose	30	$1.48
Sucrose and Dextrose	Sucrose 25 Dextrose 7	$1.56
Sucrose and Honey	Sucrose 22 Honey 8	$1.656

At present prices, therefore, the honey and sucrose mixture is somewhat more expensive. Reducing this to a cost per gallon basis, assuming that 30 per cent overrun is taken, the increased cost of using the honey amounts to approximately 1.5 cents a gallon.

SUMMARY

1. A study of the effect of honey on the crystallization of sucrose in water-ices showed that honey will very largely prevent this defect appearing.
2. Examination of the various batches of water-ice for flavor brought out the fact that when golden grade of honey was used it had no injurious effect on the flavor. The flavor lasted a little longer, and in some cases there was a suggestion of a honey flavor, while in other cases the presence of honey would not be detectable. The presence of the honey flavor did not detract from the general flavor, but was considered an improvement by some of those testing the samples.
3. Results obtained indicated that 22 per cent sucrose and 8 per cent golden grade honey would give the most desirable results.
4. Honey was successfully used with various flavors.
5. Where milk was used at the rate of 50 per cent in the sherbet mix the results with honey were not very satisfactory. Where ice cream mix was used the defect in flavor did not appear.
6. Freezing point determinations made on all sucrose, sucrose and honey, and sucrose and dextrose mixes, showed, as would be expected, that the invert sugars depressed the freezing point somewhat.
7. At present prices, the cost of the sweetening agents when either the dextrose or honey is used in combination with sucrose, is slightly greater than when sucrose is used alone.

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INHERITANCE OF FLOWER COLOUR IN A CROSS BETWEEN WHITE BLOSSOM AND YELLOW BLOSSOM SWEET CLOVER (*Melilotus albus* Desr. × *M. officinalis* (L) Desr.)

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[Received for publication, October 30, 1930]

In an article on natural crossing between the white blossom and yellow blossom species of common biennial sweet clover (*2*) the writer reported the occurrence of a single hybrid. Only one such individual was found among a population of 11,400 plants which were grown from seeds produced under optimum conditions for cross-pollination. The small percentage of natural crossing in this experiment seemed to indicate that hybrids between these two species were of rare occurrence.

In a subsequent paper (*3*), the writer reported the results of an extensive series of artificial crosses between white blossom and yellow blossom sweet clover without obtaining a single viable seed. That the failure was not due to faulty technique is evident from the large numbers of abnormal seed structures which were obtained. This work was repeated in full under greenhouse conditions during the winter of 1929-30 with identical results. In view of the fact that hybrid seed capable of producing plants was not obtained and since an explanation, at least in part, was found in the phenomenon of abnormal seed, one should not expect that natural hybrids would be found very frequently.

The fact remains, however, that a single hybrid was obtained in the experiment on natural crossing. This plant had cream colored flowers which were conspicuously different in shade of yellow from existing varieties. Sylven (*4*) has recently reported the finding at Svalof, Sweden, of three sweet clover plants with pale yellow flowers. These were judged to be natural hybrids on the basis of flower colour, excessive pollen sterility, and intermediate flower size.

Taking advantage of the natural hybrid referred to above, a genetic study was undertaken to determine the inheritance of flower colour in the cross *M. albus* × *M. officinalis*. It is the purpose of the present paper to present the results of this experiment.

Experimental Methods

On account of the fact that very few seeds can be obtained from plants of *M. officinalis* when insects are excluded (*1*) and because we were especially desirous of securing seed from the hybrid plant with cream coloured petals, no attempt was made to prevent cross pollination by artificial means. This omission involved considerable risk since the male gametes of the pure white flowered species might be more effective on ovules of the F_1 plant than its own male gametes. It is frequently the case that the F_1 of species crosses are more fertile when backcrossed than when selfed. However, it seemed preferable to risk the possibility of backcrossing with white flowered plants than

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to prejudice the chance of securing seed from the F_1 hybrid by caging it or bagging the racemes, a procedure wich proved so fruitless in the case of *M. officinalis*.

If an appreciable amount of backcrossing with the white flowered species should take place, it could probably be detected easily in the second and third hybrid generations. If this should occur, there would certainly be an excess of white or possibly light cream flowered plants in the second and third generation progenies. In fact, this proved to be not the case, as will become evident from the data.

The F_1 plant produced a very small amount of seed although no superficial evidences of sterility were visible, such as have been observed from time to time in sweet clover plants. An F_2 progeny of 150 plants was grown in 1928. During the first season about three-fourths of the plants had yellowish green foliage. This chloratic condition was more pronounced in the early shoots of the second season's growth but later the foliage seemed to regain the normal green colour.

All the F_2 plants blossomed and produced seed in 1929. The plants were classified into five groups with respect to flower color, namely white, dull white, light cream, dark cream and yellow. The different shades of colour were distinct but difficulty was experienced sometimes in assigning plants to the proper group. Originally, two shades of yellow were distinguished but these were most difficult to recognize and eventually both were classified simply as yellow.

Presentation of Results

The results obtained in the second generation suggested that at least two, and possibly three factors were involved. It appeared also that the relation between the determiners must be somewhat complex since neither a two or three factor hypothesis would satisfy the data if they were taken to be independent and of equal value. An exceptionally good fit, however, was secured by assuming two dominant factor pairs for cream which together in the homozygous condition give yellow, with the further assumption that the one factor pair has a stronger effect than the other and both are more effective in the homozygous than in the heterozygous condition. With this hypothesis, the observed and expected results appear as follows:

	White	Dull White	Light Cream	Dark Cream	Yellow
Observed	11	18	54	55	12
Expected	10	19	66	47	9

In order to check the accuracy of classification in F_2 and secure further information on the breeding behavior of plants with flowers of different colors, a strenuous effort was made to secure self-fertilized seed from plants in each of the color classes. Altogether 54 F_3 families were grown. Seedlings were started in the greenhouse and later transplanted into the field. The plants blossomed in 1930 and were classified on the basis of flower colour. The number of plants in each family was fairly satisfactory except in the case of yellow plants from which selfed seed was secured with the greatest difficulty.

The colour classes used in F_2 provided a satisfactory basis for classification in F_3, but in the later generation, it was not so easy to distinguish between white and dull white or between light and dark cream. The distinction between dull white and light cream was usually fairly well marked as was also the difference between dark cream and yellow. Even here, there was some chance of error in a very few cases. It was very obvious, however, that the same shades of colour for the different colour classes were not alike in all families. The dark cream class, for example, was a deeper cream colour in some families than in others and the same could be said of each of the other colour classes. It was necessary, therefore, to consider each family independently with respect to the relative degree of yellow in each class. This difficulty complicated the problem of classification and made it less easy to distinguish the two creams and the two whites with certainty. It was considered advisable, therefore, with respect to F_3 progenies, to group the whites and creams, designating whites and dull whites as "white" and light and dark creams as "cream".

From a study of F_3 data, it was apparent that a few errors of classification had been made in the F_2. These are indicated in Table 6. Another feature of the F_3 data is the large number of F_2 whites which gave creams and creams which gave whites. This fact not only made the two factor hypothesis suggested above untenable, but also indicated the presence of an inhibiting factor*.

The data for F_3 families which were produced from F_2 parent plants with white (white and dull white), light cream, dark cream and yellow colored flowers are given in tables 1, 2, 3 and 4 respectively. The theoretical ratio to which each progeny has been assigned is indicated for each F_3 family. The goodness of fit was tested by the X^2 distribution. In all cases, the agreement between the observed and expected frequencies was found to be satisfactory except in those cases which have been indicated by an asterisk. Families which were transferred from one F_2 colour class to another on the basis of F_3 data are grouped and reasons for the adjustments are stated.

TABLE 1.—*Observed frequencies in F_3 families of M. albus x M. officinalis descended from F_2 plants with white or dull white flowers.*

F_2 plant number	F_3 colour class frequency		Ratio
	white	cream	
2	134		True breeding
4	66		" "
5	52		" "
8	55		" "
9	41		" "
11	99		" "
13	132		" "
7	43	24	3 W : 1 C*
1	65	7	13 W : 3 C
3	129	18	13 W : 3 C*
12	42	4	13 W : 3 C

* Agreement fair.

*The suggestion of an inhibiting factor was made by Dr. W. P. Thompson after a careful examination of the data.

TABLE 2.—*Observed frequencies in F_3 families of M. albus x M. officinalis descended from F_2 plants with light cream coloured flowers.*

F_2 plant number	F_3 colour class frequency			Ratio
	white	cream	yellow	
10		37		True breeding
15	36	93		1 W : 3 C
19	37	89		" "
22	16	80		" "
28	14	32		" "
30	12	33		" "
31	12	22		" "
41	34	100		" "
42	8	44		" "
43	8	34		" "
44	6	34		" "
45	25	85		" "
46	7	23		" "
47	13	39		" "
48	11	45		" "
49	13	16		*
52	2	23		*
53	5	53		*
54	16	33	1	13 W : 46 C : 5 Y
Transferred from dull white group because of a preponderance of creams				
6	8	40		1 W : 3 C
50	19	73		" "
51	33	102		" "
Transferred from dark cream group because of a deficiency of yellows				
23	11	33		1 W : 3 C
27	3	10		" "
40	7	44		" "
34	4	28	1	13 W : 46 C : 5 Y
35	2	30		*
36	3	34		*
37	7	74		*
38	8	84		*

* Agreement unsatisfactory.

TABLE 3.—*Observed frequencies in F_3 families of M. albus x M. officinalis descended from F_2 plants with dark cream coloured flowers.*

F_2 plant number	F_3 colour class frequency			Ratio
	white	cream	yellow	
24		65		True breeding
25		53		" "
26		36		" "
32		26		" "
33		39		" "
29	7	37	3	1 W : 12 C : 3 Y*
39	3	91	12	1 W : 12 C : 3 Y
Transferred from yellow group because of a deficiency of yellows				
14		6		True breeding
16	1	26	13	1 W : 12 C : 3 Y

* Agreement only fair.

TABLE 4. *Observed frequencies in F_3 families of M. albus x M. officinalis descended from F_2 plants with yellow coloured flowers.*

F_2 plant number	F_3 colour class frequency		Ratio
	cream	yellow	
17		1	
18		1	
20		8	True breeding
21	19	38	1 C : 3 Y

GENETIC HYPOTHESIS AND AGREEMENT WITH EXPECTATION

The data presented for the inheritance of flower colour in the cross *M. albus* × *M. officinalis* can be explained satisfactorily by assuming two factors, C_1 and C_2, for cream which together give yellow, and a third factor W from the white flowered parent which inhibits the action of C_2. It must be assumed further that C_1 is stronger in its effect than C_2. Plants with C_1 in the homozygous condition give dark cream when C_2 is homozygous recessive or inhibited by W, but in the heterozygous condition C_1 always produces light cream; C_2 C_2 and C_2 c_2 also produces light cream when C_1 is recessive. The W factor completely inhibits only when present in the homozygous condition and produces dull white when heterozygous for this factor. The theoretical frequency and constitution of F_2 plants together with expected ratios in F_3 are given in table 5.

TABLE 5.—*Melilotus albus* x *M. officinalis. Theoretical frequency and constitution of F_2 plants with expected ratios in F_3 families, assuming two factors for cream, C_1 and C_2, which together give yellow and a third factor W which inhibits the action of C_3.*

Constitution of F_2 plants				Phenotype	Ratios in F_3 families
1	C_1 C_1	C_2 C_2	W W	dark cream	True breeding
2	C_1 c_1	C_2 C_2	W W	light cream	3 C : 1 W
2	C_1 C_1	C_2 c_2	W W	dark cream	True breeding
2	C_1 C_1	C_2 C_2	W w	dark cream	3 C : 1 Y
4	C_1 c_1	C_2 c_2	W W	light cream	3 C : 1 W
4	C_1 c_1	C_2 C_2	W w	light cream	10 C : 3 W : 3 Y
4	C_1 C_1	C_2 c_2	W w	dark cream	13 C : 3 Y
8	C_1 c_1	C_2 c_2	W w	light cream	46 C : 13 W : 5 Y
1	C_1 C_1	C_2 C_2	w w	yellow	true breeding
2	C_1 c_1	C_2 C_2	w w	yellow	1 C : 3 Y
2	C_1 C_1	C_2 c_2	w w	yellow	1 C : 3 Y
4	C_1 c_1	C_2 c_2	w w	dark cream	12 C : 1 W : 3 Y
1	C_1 C_1	c_2 c_2	W W	dark cream	true breeding
2	C_1 c_1	c_2 c_2	W W	light cream	3 C : 1 W
2	C_1 C_1	c_2 c_2	W w	dark cream	true breeding
4	C_1 c_1	c_2 c_2	W w	light cream	3 C : 1 W
1	c_1 c_1	C_2 C_2	W W	white	true breeding
2	c_1 c_1	C_2 c_2	W W	white	true breeding
2	c_1 c_1	C_2 C_2	W w	dull white	1 C : 3 W
4	c_1 c_1	C_2 c_2	W w	dull white	3 C : 13 W
1	c_1 c_1	c_2 c_2	W W	white	true breeding
2	c_1 c_1	c_2 c_2	W w	white	true breeding
1	c_1 c_1	C_2 C_2	w w	light cream	true breeding
2	c_1 c_1	C_2 c_2	w w	light cream	3 C : 1 W
1	C_1 C_1	c_2 c_2	w w	dark cream	true breeding
2	C_1 c_1	c_2 c_2	w w	light cream	3 C : 1 W
1	c_1 c_1	c_2 c_2	w w	white	true breeding

According to the hypothesis outlined in table 5, the theoretical frequencies in the five F_2 colour classes would be as follows:

W.	D.W.	L.C.	D.C.	Y.	Total
7	6	29	17	5	64

Table 6 gives the actual frequencies observed in F_2 and the adjustments which were made necessary by the breeding behavior in F_3. The F_2 frequencies after adjustments had been made are also given, together with the frequencies expected on the basis of the hypothesis which has been suggested. The goodness of fit test shows X^2 to be 3.48 for N = 4 and P = approximately 0.5. The agreement with expectation is, therefore, very good.

TABLE 6.—*Observed ferquencies in F2 flower colour classes in the cross M. albus x M. officinalis, with adjustments on the basis of F3 data, in relation to theoretical expectation.*

Colour classes	White	Dull White	Light Cream	Dark Cream	Yellow	Total
Numbers observed in F_2	11	18	54	55	12	150
Adjustments in the F_2 ratio on the basis of F_3 families	→ 3	2 ← →	8 3	← 2	←	
F_2 frequencies after making necessary transfers	12	14	65	49	10	150
Theoretical ratio	16	14	68	40	12	150

$X^2 = 3.48$ P = approximately 0.5

The procedure adopted in table 6 could be criticized on the ground that further adjustments in the F_2 observed frequencies would have been necessary had all of the F_2 plants produced F_3 progenies. It is impossible to estimate how this would have affected the agreement but even if progenies from all of the F_2 plants had been grown and a proportionate number of adjustments found necessary (approximately three times as many), the agreement would have been still satisfactory.

As a matter of interest, the agreement was tested also on the basis of the 54 F_3 families which were grown. The figures are given in table 7. Total X^2 is 3.6 for N = 4 and P = .5 to .3. Here again the fit is exceptionally good.

TABLE 7.—*Agreement with expectation in F3 flower colour classes in the cross M. albus x M. officinalis with reference only to families grown in the third generation.*

Colour classes	White	Dull White	Light Cream	Dark Cream	Yellow	Total
Families grown in F_3 as classified in F_2	6	8	19	15	6	54
Ratio in F_2 after reclassification	7	4	30	9	4	54
Expected	6	5	24.5	24.3	4.2	54

$X^2 = 3.6$ P = .5 to .3

Returning to a consideration of tables 1, 2, 3 and 4, it is important to investigate the agreement with expectation within each of the family groupings in F_3 to see how far the data has substantiated the three factor hypothesis to account for the frequencies observed in each of the F_2 colour classes. Eleven F_3 families were grown from F_2 plants with white or dull white flowers. Reference to tables 1 and 5 shows the agreement to be very good.

Breeding in F_3	*Expected*	*Observed*
True breeding	7	7
3 W : 1 C	2	1
13 W : 3 C	4	3
	13	11

In two of the eleven families the fit is only fair but on the whole, it is very satisfactory.

Table 2 gives the frequencies observed in F_3 families descended from F_2 plants with light cream flowers. A comparison with expected frequencies is given below:

Breeding in F_3	*Expected*	*Observed*
Tree breeding	1	1
3 C : 1 W	16	20
10 C : 3 W : 3 Y	4	0
46 C : 13 W : 5 Y	8	2
Unclassified		7
	29	30

In this case the agreement in all but seven families out of 30 is excellent. Four of those which fit the ratio 3 C : 1 W would also satisfy the ratio 10 C : 3 W : 3 Y except for the absence of yellow plants.

It is very obvious that there is a serious deficiency of yellows. In addition to those already mentioned, eight families out of 29, having the constitution C_1 c_1 C_2 c_2 Ww, should give the ratio 46 C: 13 W : 5 Y. Only two were found. In these cases the absence of yellow flowered plants could more easily occur by chance since only 5 yellows out of 64 plants were expected.

Table 3 gives the frequencies in F_3 families descended from F_2 plants with dark cream colored flowers. The observed and expected frequencies are as follows:

Breeding in F_3	*Expected*	*Observed*
True breeding	7	6
3 C : 1 Y	2	0
13 C : 3 Y	4	0
12 C : 1 W : 3 Y	4	3
	17	9

Here again there is a deficiency of yellow flowered plants in all of the classes where they should occur. This may account for the excess of true breeding families, some of which otherwise might have given ratios of 3 C : 1 Y or 13 C : 3 Y. Of the three observed families which were assigned to the ratio 12 C : 1 W : 3 Y, one gave a good fit, in a second the fit was only fair, while the third was far from satisfactory.

Table 4 gives the observed frequencies in F_3 from F_2 yellow flowered plants. Out of 5 plants which had yellow flowers in F_2, one should breed true and four should give ratios of 1 C : 3 Y in F_3. Of those observed, one bred true for yellow flowers and another satisfied the ratio 1 C : 3 Y. The other two families had only one surviving plant each and these were yellow flowered. As previously stated, it was difficult to secure selfed seed from yellow flowered plants. This accounts for the small numbers in three of the four families.

It is interesting to note that according to the hypothesis as stated, there are two factors of unequal value for cream which makes it clear why the shade of yellow for a given colour class might be expected to be different in different F_3 families.

Taking the F_3 data as a whole, we may say that, except for the deficiency of yellow plants, the results tend to support the hypothesis which has been suggested to explain the inheritance of flower colour in the species cross under consideration. Just why there should be a deficiency of yellow flowered plants is not apparent, except that in certain cases, the absence of yellow could be due to chance. But having regard to the complex nature of the problem and the inherent difficulty of classifying plants on a flower colour basis, the agreement with expectation may be regarded as exceptionally good. This is particularly true in tests of significance applied to F_2 data.

Mention should be made in passing of evidence of sterility in F_3 families. Much variability was observed in the ability of individual plants to set seed but of greater interest is the fact that a few families contained a considerable number of completely sterile plants. In these cases of complete sterility, the flowers had a peculiar abnormal appearance due to the fact that they had not developed properly. The petals were present, however, in all cases but much less conspicuous than on normal flowers.

It may also be mentioned that all of the plants showed good development though the plants in some families were twice the size of those in other families. The only exceptions to this were the yellow flowered plants in F_2, all of them being relatively very small.

Summary

1. This paper reports the results of an inheritance study of flower colour in a cross between *Melilotus albus* and *Melilotus officinalis*.

2. The F_1 plant had cream or pale yellow coloured flowers.

3. An F_2 progeny consisting of 150 plants was grown. These plants were classified with respect to flower colour as follows: 11 white: 18 dull white: 54 light cream: 55 dark cream: 12 yellow.

4. The frequencies for flower colour classes obtained in F_2 were in close agreement with a three factor hypothesis, assuming two factors for cream, C_1 and C_2, which together give yellow, and a third factor W from the white flowered parent which inhibits the action of C_2. It is assumed also that C_1 has a greater effect in producing cream than C_2.

5. Fifty-four families were grown in F_3, the numbers from each of the F_2 colour classes approximating closely the proportion in which they occurred in F_2. In general, the F_3 data supported the hypothesis in question, but there was a deficiency of yellow plants in a majority of the families where these should have been found.

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THE CANADIAN PHYTOPATHOLOGICAL SOCIETY

As a result of the elections recently held, the personnel of the Council for the year 1931 will be as follows:—

President—W. P. Fraser, University of Saskatchewan, Saskatoon, Sask.

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The Ontario Committee in charge of the 1931 C.S.T.A. Convention has invited the Canadian Phytopathological Society to meet with the C.S.T.A. at the Ontario Agricultural College during the week of June 22nd. It is expected that this invitation will be accepted.

SULPHUR DUSTING FOR THE PREVENTION OF A BACTERIAL DISEASE OF WHEAT CALLED BLACK CHAFF*

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[Received for publication November 22, 1930]

In an experiment designed to study the effectiveness of sulphur in controlling leaf rust (*Puccinia triticina* Erikss.), and some of the minor leaf and stem diseases of wheat, it was found that frequent applications of sulphur dust prevented the development of a bacterial disease of wheat called Black Chaff. The results of this preliminary study were so promising that it seemed advisable to present a brief summary of them.

PLAN OF EXPERIMENT

For the purpose of the study, a strain of wheat from a cross H-44-24 × Marquis, obtained from the Cereal Division, Dominion Rust Research Laboratory, was used. This strain is of no particular agronomic value but is of interest because of its resistance to stem rust and susceptibility to leaf rust. Thus, by eliminating the effects of stem rust, it was hoped by sulphur dusting experiments to determine the effect of leaf rust on yield.

The inheritance of resistance to black stem rust (*Puccinia graminis tritici* Erikss. and Henn.) in the H-44-24 × Marquis cross, has been described by Goulden, Neatby and Welsh (*4*). The particular strain used in this experiment was shown to be uniformly resistant to stem rust by tests in which a severe artificial epidemic of the disease was produced. Although most of the strains from this cross are resistant to leaf rust some of them appeared to be moderately susceptible to it. One of the apparently susceptible strains was selected for this study.

The wheat was sown on May 25, in forty-eight 18-foot rows, one foot apart; fifteen grams of seed were sown in each row. The rows were arranged as follows: 3 rows of Garnet wheat for border; one row of hybrid wheat dusted with sulphur; 4 rows of Garnet to serve as a buffer against dust drift; 2 rows of hybrid wheat not dusted (checks); 4 rows of Garnet; 2 rows of hybrid wheat dusted with sulphur; 4 rows of Garnet; 2 rows of hybrid wheat not dusted; 4 rows of Garnet, etc., etc. This arrangement extended over two series each containing 12 dusted and 12 undusted rows of hybrid wheat, besides border and buffer rows of Garnet. In this arrangement the adjacent dusted and undusted rows were considered as a pair, and the experimental yield data were subjected to statistical analysis. A completely random arrangement of pairs would have been more desirable from the standpoint of the analysis of the results, but it was necessary to have dusted components of different pairs together, so the randomized plan was impractical. The arrangement of the experiment is shown in figure 1.

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‡The writer has great pleasure in acknowledging his indebtedness to Dr. C. H. Goulden, of the Dominion Rust Research Laboratory, for helpful criticism.

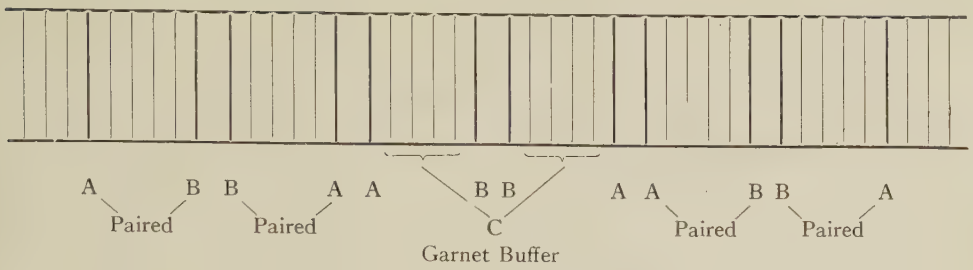

Figure 1. Arrangements of rows in sulphur dusting experiment. The A rows were dusted with sulphur; the B rows were left undusted (checks). The C rows of Garnet served as a buffer against dust drift.

Dusting was commenced July 11, and thereafter half of the wheat hybrid rows were treated at 3-day intervals until August 19 when the wheat was ripening. At each dusting, Kolodust was applied at the rate of 15 pounds per acre with an ordinary hand duster. In previous studies (*6*) this treatment had given almost complete control of stem and leaf rust.

Experimental Results

On August 22, when the rows were practically mature, a very light trace of stem rust was found on a few of the H-44-24 × Marquis hybrid plants. Although this wheat hybrid was considered to be moderately susceptible to leaf rust, this disease did not develop on the undusted plants to any marked extent and it was almost completely prevented on those which were dusted with sulphur.

At harvest time, the amount of leaf rust infection in the undusted check rows of hybrid wheat ranged from a trace to 25 per cent, with an average severity of 15 per cent; while only a trace of leaf rust was found on any of the dusted plants. Moreover, the rust pustules were small and necrotic, indicating a considerable degree of plant resistance. It is possible, that the physiologic forms to which this wheat hybrid is susceptible were not present in the experimental plots at Winnipeg in 1930.

Notwithstanding the light leaf rust attack it must be assumed that a slight reduction in yield due to leaf rust would result. A study of the experimental yield data, however, revealed a very decided difference in favour of the dusted plants, and, in the absence of significant amounts of leaf and stem rust, it seemed that the greatly increased yield of the dusted wheat hybrid plants was due to the control of other injurious diseases.

When the final disease notes were taken it was observed that the undusted rows of the H-44-24 × Marquis hybrid were heavily infected wtih a bacterial disease called black chaff, whereas very little was found on the dusted rows. When dusting was commenced the rows were thoroughly examined, but not a trace of the black chaff disease was found. By July 25, a number of small striated lesions were observed at the last node of many of the undusted check plants, and an occasional dusted plant showed signs of the disease. In spite of the dry weather during the later stages of plant growth, heavy dews frequently occurred during the period July 15 to August 15. Apparently, this helped to bring about conditions favorable for the develop-

ment of the disease, for, by August 10, the undusted check rows of hybrid wheat were heavily infected.

At harvest time, the black chaff disease data were estimated on the percentage basis after actual counts of the number of infected plants in the dusted and undusted rows had been made. In previous investigations, Goulden and Neatby (*5*) showed that the amount of infection on different portions of the plant seemed to be closely correlated. In this study the type of infection was uniform for all parts of the plant so that one estimate only was taken. In the rows of hybrid wheat, the percenatge of undusted plants infected with black chaff ranged from 65 to 95, with an average of 75 per cent; whereas the range of the dusted plants was from a trace to 8 per cent, with an average of 4 per cent.

Black Chaff of Wheat

The disease we have called black chaff has not been positively identified as black chaff disease caused by *Bacterium translucens* var. *undulosum*, Smith, Jones, and Reddy, and described by Smith (*8*), but in general symptoms it is identical with black chaff. Popp * isolated two distinct bacteria from wheat plants apparently affected with the same disease, collected in the breeding nursery at Winnipeg in 1928. When susceptible host plants were inoculated with one of these organisms and held under controlled conditions in the greenhouse, typical black chaff symptoms were produced.

The presence of black chaff (*Bacterium translucens* var. *undulosum* Smith, Jones and Reddy) in Manitoba was first reported in 1921, by Bisby and Buller (*1*), when it was found to occur occasionally on *Triticum aestivum*. Plant disease surveys (*2*) indicate that some specimens of black chaff were collected in Manitoba, where light damage resulted, in 1923 and 1924. Black chaff was not found in 1925. The disease appeared in the cereal breeding nursery at Winnipeg in 1926. In that year it was found only on the variety H-44-24 and the more susceptible of its hybrids with Marquis. In 1927, the disease occurred in the breeding nursery at Morden, Manitoba; and a large field of Ceres wheat at Graysville, Manitoba, was found to be severely affected. The infection was much heavier and the disease more injurious than in the previous year. Black chaff appeared at Winnipeg with increased severity in 1928, and many varieties and strains of wheat being attacked to some degree. In 1929, black chaff infection was observed again in the breeding nursery at Winnipeg. The variety H-44-24 and its susceptible hybrids with Marquis were heavily infected.

The effect of the black chaff disease varies on different varieties. On the variety H-44-24 and some of its hybrids with Marquis, the infections are characterized by dark brown lesions, more or less striated, and confined mainly to the neck and head of the plant. If the infection is very severe, the lesioning extends over the entire plant, appearing first below the last node and later over the neck and head. Head and neck lesions are usually patchy, and rarely, if ever, as continuous as are the lesions below the last node. The discoloration is usually uniform and extends over the entire culm and head.

*The writer is indebted to Wm. Popp, Assistant Plant Pathologist of the Dominion Rust Research Laboratory, Winnipeg, for access to unpublished work on this disease.

On heavily infected plants the presence of an exudate, consisting of tiny beads of bacterial masses oozing from stomata, can be detected. Some of the H-44-24 × Marquis strains are quite resistant to the disease. The general appearance of the disease and the type of lesions on some other varieties, is quite different from the symptoms described for H-44-24 and certain H-44-24 × Marquis hybrids.

The results of the sulphur dusting experiment suggest very strongly that the organism causing black chaff spreads from plant to plant in the field. Among extraneous agents of transmission of the disease, insects have been suggested as playing a part. It would seem, however, that wind and rain are the most important agents of dissemination.

Yield Results

The dusting schedule followed in the experiment, together with the results of dusting with Kolodust on the percentage of plants infected with black chaff, kernel weight, weight per bushel, yield in bushels per acre, and grade, are given in table 1. Heads and stems of dusted and undusted H-44-24 × Marquis hybrid plants, are shown in figures 2 and 3. From a study of table 1 it is apparent that frequent applications of sulphur dust largely prevented the development of black chaff.

Yield per rod row of the dusted and undusted plants and the results of the statistical calculations with the experimental data are presented in table 2. The significance of the difference between the paired values was tested by the method given by Fisher (*3*). In determining the significance of the difference between the paired values we find $t = 5.37$. Since a t value of 2.81 gives 100:1 odds, the difference observed here is highly significant.

Goulden and Neatby (*5*) analyzed the data from rod rows of wheat grown in the breeding nursery at Winnipeg in 1928, and found that black chaff was negatively correlated with yield. In a similar experiment, Hayes, Aamodt and Stevenson (*7*) obtained significant negative correlations between black chaff and the yield of wheat. From a study of the data presented in tables 1 and 2 it would seem that the increased yield of the dusted rows, of 5.9 bushels per acre, was in a large part due to the control of black chaff.

The quality of the threshed grain from dusted plants kept relatively free of leaf rust and black chaff was improved, and kernel weight, and weight per measured bushel were increased. An analysis of the 1000-kernel weight results for the 24 comparisons, gave a t value of 13.26. Using Fisher's tables, it is evident that the odds of significance are very much greater than 100:1. The average increase in weight of 1000-kernels in favor of the dusted plants was 3.9 grams.

Summary

It was found that frequent applications of sulphur dust prevented the development and spread of a bacterial disease of wheat called black chaff. In the absence of significant amounts of leaf and stem rust it would seem that the increased yield of 5.9 bushels per acre resulting when rows of an H-44-24 × Marquis hybrid were dusted with Kolodust, was due in part to the control of black chaff.

TABLE 1.—*Effect of dusting wheat with sulphur at the rate of 15 pounds per acre, per application, in rod rows at Winnipeg, Man., in 1930.*

Treatment of rows	Date of dust application		Percentage of plants infected with black chaff		Average weight per 1000 kernels grams	Weight per bushel pounds	Yield per acre bushels	Grade
	July	August	Range	Average				
Dusted	11, 14, 17, 20, 23, 26, 29.	1, 4, 7, 10, 13, 16, 19.	tr-8	4	35.0	60.	30.9	1°
Undusted (Checks)	.....	.....	65-95	75	31.1	58.5	25.0	2°

Figure 2. Heads of H-44-24 X Marquis wheat hybrid showing control of the bacterial black chaff disease by dusting with sulphur. Left; head not dusted, infected with black chaff. Black stripes on glumes and rachis. Right; head dusted, not infected.

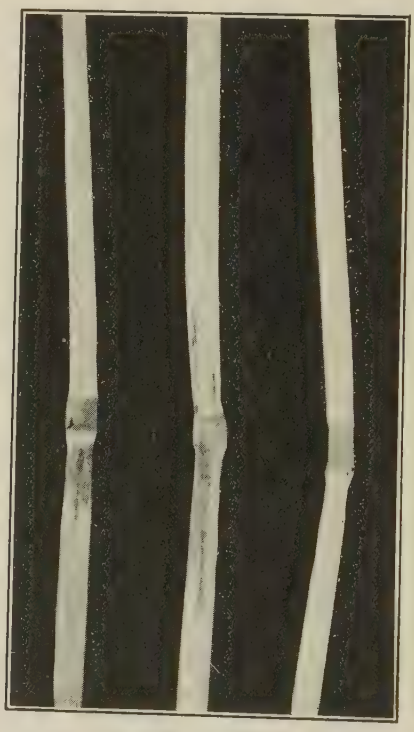

Figure 3. Stems of H-44-24 X Marquis wheat hybrid showing control of the bacterial black chaff disease by dusting with sulphur. Left; two stems not dusted, infected with black chaff. Black lesions below nodes. Right; stem dusted, not infected.

TABLE 2.—*Effect of dusting wheat with sulphur at the rate of 15 pounds per acre, per application, on the rod row yields in bushels per acre, and the statistical estimation of the difference between yields of dusted and undusted check plots, at Winnipeg, in 1930.*

Paired rows	Yield of rod rows in bushels per acre		D	D^2
	Dusted	Undusted		
1–2	27.9	21.9	6.0	36.00
4–3	31.2	21.9	9.3	86.49
5–6	27.7	29.5	−1.8	3.24
8–7	34.8	22.9	11.9	141.61
9–10	30.4	25.7	4.7	22.09
12–11	28.4	26.9	1.5	2.25
13–14	23.3	29.2	−5.9	34.81
16–15	31.4	29.0	2.4	5.76
17–18	31.5	25.6	3.9	34.81
20–19	37.8	20.9	16.9	285.61
21–22	29.6	20.5	9.	82.81
24–23	29.7	23.5	6.2	38.44
25–26	28.3	18.1	10.2	104.04
28–27	38.0	27.8	10.2	104.04
29–30	29.0	30.4	−1.2	1.44
32–31	36.0	31.0	5.0	25.00
33–34	35.1	25.2	9.9	98.01
36–35	30.4	22.7	7.7	59.29
37–38	27.5	23.8	3.7	13.69
40–39	28.8	21.0	7.8	60.84
41–42	35.5	25.3	10.2	104.04
44–43	33.7	22.3	11.4	129.96
45–46	27.8	30.5	−2.7	7.29
48–47	29.0	26.5	2.5	6.25
Yield Total	743.0	602.1	24/140.9	24/1487.81
Average	30.9583	25.0875	5.8708	61.9920
				34.4662
Difference = 5.87				27.5258

$$\text{S. D.} = \sqrt{61.9920 - (5.8708)^2} = 5.2465$$

$$t = \frac{5.8708 \times \sqrt{23}}{5.2465} = 5.37$$

5% point = 2.07 1% point = 2.81

Therefore odds are much higher than 100:1

Dusting increased the yield and improved the quality of the grain. In addition, the experiment has indicated that when favorable conditions for its development occur, the organism causing the black chaff disease spreads from plant to plant in the field.

In conclusion it is well to point out that the results given are purely of preliminary value and only indicate possibilities of the practical value of sulphur dusting for the control of black chaff. Furthermore, since most of the commonly grown varieties of spring wheat appear quite resistant to black chaff, it is not likely that varieties or strains as susceptible as the one used in this experiment will ever be grown generally. More extensive field experiments are under way to determine the relation between black chaff and the yield of susceptible wheat strains.

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STATISTICAL ANALYSIS OF COMPARATIVE FEEDING TRIAL DATA *

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[Received for publication October 1, 1930]

The interpretation of the results obtained from comparative feeding trials is perhaps the most difficult phase of such projects. This is true for several reasons, the chief of which is the extreme variability shown by individual animals in their response to the imposed experimental conditions. This characteristic introduces a degree of uncertainty in any average figure which may be calculated from data so obtained. The fewer the numbers upon which such averages are based the more serious does this factor become in lessening the dependence which can be placed in the average results of the trial.

For this reason, trials are repeated again and again, and conclusions are even then made "on the safe side" in order to make allowances for the effects of this variability.

Recently some attempt has been made to determine by statistical methods, the reliability of such averages as are obtained in feeding trials. Through a calculation of the so called "Probable Errors" of the average gains or productions we are able to get some idea of the extent of the effects on these averages of the many factors operating other than the imposed experimental condition being studied.

It is not the purpose of this paper to discuss the calculation, nor significance of such measures of variation as standard deviation, coefficient of variability or probable error, but rather to present in brief form a plan for the application of certain statistical calculations in the analysis of the data obtained from comparative feeding trials.

In the statistical analysis of comparative feeding trial data one of the most useful ways of expressing this degree of reliability of the averages is in terms of "necessary differences" which must exist between the groups under comparison (with whatever degree of certainty is demanded) before any effects of the imposed conditions can safely be counted,—the necessary difference representing the sum total of the effects of the uncontrolled conditions of the trials.

The magnitude of the necessary difference found will depend upon two factors, the number of animals or observations upon which the averages are based and their uniformity. The larger the number of animals and the more uniform their performance, the smaller the allowance necessary to cover this uncontrolled variability.

This calculation may be made from the probable error of the difference which in turn is obtained from the probable errors of the two averages being compared. (The probable error of a difference is equal to the square root of the sum of the squared probable errors of the two averages). This result multiplied by 3.17 gives the "necessary difference" which, with odds of 30

*Paper given at the annual meeting of the Eastern Canada Society of Animal Production, Wolfville, N.S., June 26, 1930.

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to 1, must exist between the two average results to include the effects of the uncontrolled variation in the trial.

The procedure involved in this method of determining Necessary Differences and subsequently the Net Differences is shown in Table 1.

TABLE 1

	Lot 1	Lot 2
Average gain per 100 lbs. feed eaten	25. ± .5 lbs.	30. ± .7 lbs.
Difference in favor of Lot 2	5. ± $\sqrt{(.5)^2+(.7)^2}$	
	— 5. ± .86 lbs.	
Necessary difference to include uncontrolled variation	.86 x 3.17 = 2.72 lbs.	
Difference in favor of Lot 2 creditable to differences in imposed experimental conditions or "Net difference"	5 lbs. — 2.72 lbs. = 1.28 lbs gain per 100 lbs. feed eaten.	

There has been some criticism of this method of analysis on the grounds that the validity of the probable error as a measure of the reliability of an average depends upon how faithfully the variables involved represent a random sample of the populations to which they belong: and that as ordinarily allotted, groups of experimental animals are not altogether true random samples. They represent rather a selected sample, the best and the poorest being intentionally omitted. Thus efforts to effect uniformity of allotment within experimental lots may be directly opposed to the principle of random sampling.

In an effort to meet this objection a slightly different procedure involving in the analysis a modification of "Students' Method"* is now being studied at Macdonald College. Allotment is made by pairs. That is, two animals as nearly alike as it is possible to find among the total group available, are allotted one to one lot and one to the comparative lot. As many pairs as possible are selected. No attempt is made at uniformity within any lot, but extreme care is taken to see that the two members of each pair are closely alike.

In this way it is possible to include in each lot the best and the poorest as well as the average of the group of possible experimental subjects. Random sampling is at least not interfered with. Individual feeding is, of course, necessary under this plan to protect against the effects on gains or productions of differences in size, vigor, appetite, etc. between lot mates.

This plan makes necessary a change in the method of analysis, since the variability introduced within the lots would tend toward unduly large probable errors of the average gains. This difficulty is overcome by working entirely with the differences obtained between pair mates, and determining the necessary average difference as follows:

1. Find for each pair the difference in gain (or other measure of production).
2. Determine the arithmetical average difference for the number of pairs involved.
3. Calculate the standard deviation of the several differences.

*For a discussion of "Students' Method" see Jour. Amer. Soc. Agronomy. Vol. 16, No. 1. Jan. 1924.7 pp. 60-68.

4. Determine the Z value for odds of 30 to 1 according to number of pairs involved. These may be calculated from Students' Tables of Probability or for most ordinary cases read directly from table 4 found at the end of this paper.
5. The necessary difference† to cover uncontrolled variability is found by multiplying the standard deviation of the differences by the Z value necessary to give odds of 30 to 1 for the number of pairs involved.

Data from a trial now under way at Macdonald College will serve to illustrate the scheme. See table 2.

TABLE 2.

Lot 1.				Lot 2						
Pig	Gain in 32 days	Air dry feed eaten 32 days	Gain per 100 lbs. feed eaten	Pig No.	Gain in 32 days	Air dry feed eaten 32 days	Gain per 100 lbs. feed eaten	Difference in gains per 100 lbs. feed eaten	d	d^2
1	41	109	38	1a	56	115	49	11	3.6	12.96
2	36	95	38	2a	44	96	46	8	.6	.36
3	53	134	40	3a	48	104	46	6	1.4	1.96
4	47	118	40	4a	61	138	44	4	3.4	11.56
5	45	122	37	5a	47	105	45	8	.6	.36

$$\text{Mean difference} = \frac{37}{5} \qquad \Sigma = 27.20$$

$$= 7.4 \text{ lbs.} \qquad \sigma = \sqrt{\frac{27.2}{5}}$$

$$\sigma = 2.33$$

Necessary Z value for odds of 30 to 1 when n = 5.....	1.268
Necessary difference per 100 lbs. feed eaten.....	= 1.268 x 2.33 lbs.
	= 2.95 lbs.
Net difference creditable to difference in rations.....	= 7.4 lbs. - 2.95
	= 4.45 lbs.

Obviously the results in this method of analysis are not affected by variations within the groups, but only by the variations in the differences exhibited between the pair mates. As would be expected, the greater the number of pairs used, other factors being constant, the smaller the "necessary difference" needed to cover the uncontrolled variability.

This scheme has two decided advantages in certain types of comparative feeding trials. First it permits of great flexibility in the experimental procedure in that it is not necessary that all pairs be on trial at the same time. Thus in the case of a trial involving weanling pigs, the pairs may be started as they become available. Three pairs may be selected from a sow weaned on a given date; another pair from a second litter weaned a week later; and so on. Of course, in such an event not all pigs would be weighed on the same dates, but so long as the feeding periods are made the same length, and rations

†This method of determining necessary differences is one proposed by the writer and is based upon the formula $\frac{D}{\sigma} = Z$ value, in which D is the mean difference, σ equals the standard deviation of the difference between pairs, and the Z value the factor from which the values of P are found in Students' Tables of Probability Values.

and treatment are also the same, it is immaterial whether the feeding periods of the several pairs be concurrent or not.

Secondly, it offers a very simple means of combining the results of replications and measuring the reliability of their average results. This may be illustrated in the following data taken from a trial at Macdonald College reported in the April 1930 issue of *Scientific Agriculture*. Here we find six replications of essentially the same trial with results as follows: (See table 3).

TABLE 3

	Average gain per 100 lbs. feed eaten				
	Cod Liver Oil	No Cod Liver Oil	Difference	d	d^2
Period I	34.3 lbs.	35.3 lbs.	+ 1.0	1.51	2.28
II	26.3 "	25.3 "	— 1.0	.49	.24
III	29.0 "	29.1 "	+ .1	.61	.37
IV	37.7 "	36.5 "	— 1.2	.69	.48
V	31.4 "	30.6 "	— .8	.29	.08
VI	33.9 "	32.7 "	— 1.2	.69	.48
		Mean difference =	— 3.1 / 6	$\Sigma = 3.93$	
		=	— .51	$\sigma d = \sqrt{\frac{3.93}{6}}$	
				σd = .81	

Average difference in gain per 100 lbs feed eaten in favor of Cod Liver Oil Groups ..... = .51 lbs.
Z value necessary for odds of 30 to 1 with 6 observations ..... = 1.06
Necesaary difference to cover uncontrolled variation ..... = .81 x 1.06
= .86
No significant difference due to Cod Liver Oil since "average difference" is less than "necessary difference."

In discussing Students' Method as a scheme for analysing pairs of observations, Love* states, "Students' Method" is, of course, not universally applicable and is not justified where observations do not naturally fall into pairs as a result of the conditions of the experiment. . . . For observations which naturally arrange themselves in pairs, "Students' Method" is a better method with which to determine the probability of the difference. . . . "

While Love in the above discussion refers particularly to agronomic work, it would seem that there are many comparative feeding trials which might with benefit be so planned as to make possible analysis by pairs. Thus far this method has been tried at Macdonald College with pigs and with dairy cattle, and with both classes of stock allotment by pairs greatly simplified the procedure. This was particularly true in the case of dairy cattle where many factors are involved in allotment considerations which, of course, greatly increase the difficulties of obtaining comparable groups.

To what extent paired feeding may prove advantageous in comparative feeding trials remains to be seen. It is almost certain that not all trials should be conducted on such a basis, though as a means of measuring the significance of the average results of several comparable trials Students' Method would seem to offer special advantages.

A word of warning may be in order concerning the value or place of statistical analysis in the interpretation of such data as are obtained from comparative feeding trials. Let it be quite definitely understood that statistical treatment is not in any way a substitute for all other forms of analysis, and least of all for good common sense. It is rather but another and somewhat new tool or yardstick by which certain measures, particularly of reliability, may be made and which may be of assistance to the experimenter in arriving at sound conclusions as to the relative merits of the comparative conditions being studied.

TABLE 4.—*Table of Z values necessary for odds of 30 to 1. (Determined by interpolation from Students' Tables for Estimating Probability Values). (Biometrika, Vol. 11, p. 414-7).*

Number Observations	Necessary Z value	Number Observations	Necessary Z value
2	9.825	11	.663
3	2.646	12	.624
4	1.653	13	.591
5	1.268	14	.567
6	1.060	15	.544
7	.926	16	.520
8	.832	17	.498
9	.762	18	.485
10	.710	19	.472
		20	.460

* Jour. Amer. Soc. Agronomy, Vol. 16, No. 1, Jan. 1924, p. 167.

IMPERIAL BUREAU OF ANIMAL HEALTH

To the list of Imperial Bureaux recently published in *Scientific* Agriculture should be added the Imperial Bureau of Animal Health, which is located at the Veterinary Laboratory, New Haw, Weybridge, Surrey, England. The Director is Dr. W. H. Andrews. Those desiring information on this Bureau should get in touch with the Canadian Correspondent, Dr. E. A. Watson, Chief Animal Pathologist, Health of Animals Branch, Ottawa.

PROCEEDINGS OF THE SECOND ANNUAL GENERAL MEETING OF THE EASTERN CANADA SOCIETY OF ANIMAL PRODUCTION *

The second annual general meeting of the Eastern Canada Society of Animal Production was held at Acadia University, Wolfville, Nova Scotia, on June 25th and 26th, 1930. The meetings, which were well attended, were held in conjunction with the tenth annual convention of the C.S.T.A.

Dr. E. S. Archibald presented the report of the Special Nominating Committee.

In presenting this report he congratulated the Standing Committees of the Society on the comprehensive reviews of their respective fields which had proved very useful in opening up avenues of work for the Society. At the same time, the Committee and the Executive felt that the time had come when greater progress could be made by appointing Problem Committees and naming one man as chairman with respect to each specific problem. In illustration, he referred to the work on "Pasture Rejuvenation" by C. F. Bailey. This was important work and was being proceeded with by other institutions. The last word had not been said on the subject by any means, and the Committee felt that it would be of benefit to the Society at large to have one man responsible for heading up this particular work and reporting the developments from year to year to the Society as a whole. His Committee wished, therefore, to recommend that the following Problem Committees be appointed together with the name of the member associated with the problem:

Pasture Rejuvenation—	C. F. Bailey
Nutrition in Young Pigs—	R. G. Knox
Cross Breeding in Swine—	W. R. Reek
Factors influencing Butter Fat percentage in dairy cattle—	Prof. J. C. Steckley
Mineral deficiencies in dairy cattle rations—	Prof. A. R. Ness
Beef Production Costs under varying systems of management—	R. S. Hamer
Coördination in Live Stock Experimental work and policies—	Dean H. Barton
Experimental Methods—	Prof. E. W. Crampton
Live Stock Extension Methods—	A. E. MacLaurin
Imperial Bureaux—	G. B. Rothwell
Animal Health—	Chairman, Dr. A. E. Cameron Dr. Lionel Stevenson Dr. R. L. Conklin

Dr. Archibald stated that they had made an exception in the case of the Committee on Animal Health, as they felt that there was an opportunity for this Committee, as constituted, to continue to do effective work.

*This abstract has been prepared by the Managing Editor from the complete report of the proceedings submitted by Mr. L. C. McOuat and Mr. E. B. Fraser, former and present Secretaries, respectively. The President's address is given in full. Technical papers and reports of committees have been reduced considerably, but may be secured in complete form from Mr. E. B. Fraser, Animal Husbandman, Central Experimental Farm, Ottawa.

Dr. Archibald moved the adoption of this report and was second by Prof. J. C. Steckley. The motion carried unanimously.

The Secretary then read a resolution on Beef Cattle Standards which had been forwarded by Mr. Van Nice, Secretary of Western Canada Society of Animal Production.

After some discussion of this resolution, it was moved by W. W. Baird and seconded by J. W. Graham, "That the Eastern Canada Society of Animal Production hereby expresses its approval of the action taken by the Western Society in connection with Beef Cattle Standards, and recommends that the Western Committee in dealing with this matter arrange for contact with the Eastern Society through the person of R. S. Hamer". Carried.

A further resolution from the Western Society dealing with the organization of a Canadian Society was read by the Secretary.†

After discussion on this matter it was moved by Prof. Steckley and seconded by W. W. Baird, "That the Executive of the Eastern Canada Society of Animal Production appoint a Committee to meet with a similar Committee from the Western Society at the time of the forthcoming Royal to go into the matter of forming a Canadian Society." Carried.

Dr. Archibald, Chairman of the Nominating Committee, moved and Dr. Trueman seconded that the following be appointed as officers of the Eastern Canada Society of Animal Production for the ensuing year:—

President:	G. B. Rothwell.
Vice-President:	Prof. J. C. Steckley.
" "	S. J. Chagnon.
Maritime Director:	A. E. MacLaurin.
Quebec Director:	Prof. E. W. Crampton.
Ontario Director:	W. R. Reek.
Secretary:	Edward B. Fraser.

This motion carried unanimously.

Presidential Address

H. Barton
Dean of the Faculty of Agriculture, McGill University

In the Presidential addresses it is customary to dwell upon the outstanding developments in the organization during the year, to review the general conditions of the country, to indicate the action, particularly the legislative action necessary to improve them, and to predict prosperity around the corner.

I intend to do none of these but may I make a few observations that suggest themselves in the light of our experiences thus far with this Society. As a group we have certain peculiarities which I believe we shall do well to recognize. It is quite clear that we have a large potential membership, I think we may say the largest group of professionally qualified men in Canada. We have been one of the last to group ourselves around our special interest and yet it is possible that individually we have been identified with more organizations having to do with our field of work than those of any other

†This and the above resolution will be given in the report of the Western Canada Society of Animal Production to appear shortly.

group in their respective fields. There are a great many live stock organizations ranging from clubs to unions and all striving to perform useful functions; there are many special societies for specific purposes, and government machinery with many subdivisions. Our relation as an organization with these is something to think out and to develop. It would seem to be a channel through which our collective thought and action might function to advantage. We have, we consider, a special field and common interest and yet when we begin to examine it and come together in it we find it is extremely comprehensive and highly diversified. Some of us are spreading ourselves over a very wide field so our interest is general and we find ourselves being placed in the category of "general" men, or "general" workers. And, while this may even add to our strength, it makes it a little difficult for us to merge our interests and our efforts. Our American friends have developed their society to the point where they are able to section their meetings in special sessions. Some such arrangement may be advisable for us later but for the time being we must listen to one another.

Our coming together, even if only occasionally, is in itself of very distinct value and perhaps sufficient to justify the existence of such a society but this will not satisfy us, nor will it alone maintain or add to our prestige. Our society must serve us further than that. What can it do then and how must it do it? Our society is young and it may take some time to discover how it can function to best advantage, but that need not discourage us. There is surely a place for such an organization; what is more I think we need it. In any case, we have it so it is for us to adapt it and use it.

May I say that in my judgment Animal Husbandry men in Canada have been a little slow in identifying themselves, publicly at any rate, with what is regarded as the higher level of work. Post graduate work has been behind that in some other branches and men have been so occupied with what might be labelled general service that little time has been given to either study or specific investigation work. One need only read *Scientific Agriculture* to see the dearth of material coming from Animal Husbandry men. I am happy to say, however, that this state of affairs is being corrected and if the stumbling block of finance which looms so large in all live stock work can be dealt with at all satisfactorily, I am very hopeful that a lot of productive work will soon result. It would seem that this society should be able to accelerate such work. It will provide an opportunity for public presentation of work done and judging by the value of other societies in this way this should be of help to us. It will bring our men out, it ought to add to their standing and to the strength of our profession and it ought to be inspirational as well as informative for all of us.

The society ought to be a clearing house for Animal Husbandry problems. This is where a certain type of them at any rate should come to the surface, this is where their general importance can best be determined and made known and this is where, it seems to me, some understanding may be reached in regard to their treatment. This function cannot be undertaken by the society unless its members use it for this purpose.

It would appear that such a society should be able to give sound guidance to institutions and agencies that are endeavoring to serve live stock interests. There may be breed society questions, exhibition matters, yes and even

legislative enactments upon which the views of our membership should be brought to bear. We ought to be able to give some leadership to Canada's live stock development if we possess the initiative that men in our positions should have. I look forward to the time when our agenda will include questions that we will not only be expected to deal with but asked to do so. There can be no question of the standing of Animal Husbandry men in Canada. Their findings are respected and their recommendations are seldom challenged but their work is not sufficiently co-ordinated, their interpretations are not unified, nor is their collective power being felt. We must be big enough to explore this larger field of usefulness and to do this we need the kind of machinery this society can supply. May I take a very simple commonplace illustration: sheep dip. What have the Animal Husbandry men to say of sheep dip? Is there unanimity of opinion? On what is it based? Who obtained the information and what kind of information is it? You may argue that this is not a vital question. Perhaps not, but I submit that while some report has been made our knowledge of sheep dips is not sufficiently precise nor has the knowledge we may have ever been sifted and co-ordinated as it relates to our conditions. What is true of sheep dip is equally true of many other things with which there is a variety of experience and not very accurate information. If I were to venture an opinion as to the greatest weakness in our work it would be that we deal too much in generalities. I recall one statement of a professor when I was a student that was regarded as a classic. In a lecture on certain building requirements he advised that the walls should be strong enough to support the roof. I am afraid we are all still more or less guilty of such indulgences. The old books on breeding said it was both a science and an art and I suppose that statement still holds. It is our job, however, to make the science part of it and all other branches as exact as we can. It may be that in many cases we shall have to work in close co-operation with others who can bring other branches of science to our aid. That need not embarrass us if we are prepared to do our part as well as they must do theirs. It is an accepted fact that in all branches of science the majority of problems to be found are beyond the scope of any one of them. These remarks are not intended for only those who are responsible for investigation work. The man in the field must be a more exact man. He too must be an intelligent student of his own work and of that of others. He is in a position to make careful determinations in some lines of work and to record accurate data. And so it is with the administrative man who perhaps has the greatest responsibility of all in shaping policies, spending money and directing effort. A man is always influenced by the kind of work he is doing and there is great danger that he may become isolated in it. The investigator, the fieldman and the administrator is in danger of becoming submerged and narrowed in his field. Study and association are the protective measures that he must employ.

Applied work in Animal Husbandry will always be subject to a variety of local factors. Information obtained elsewhere may be vital to us but one may expect that in the last analysis we must deal with our own problems ourselves. The opportunities for service are just as great as they ever were. The field for men with Animal Husbandry training and experience is not shrinking but the character of the work required is changing and the demands

are more exacting. If our profession is to progress we must, in common with others, change our elevation and I hold it is just as important to raise the level of the extension worker as it is the teacher and the investigator. The qualifications of men for all types of positions are being scrutinized today as never before and a great deal more is expected of those who hold responsible positions. A man cannot be trained for everything nor can we afford to train him in elementary things. He can be given the kind of equipment that will enable him to develop himself, to accumulate and to apply the kind of knowledge that cannot be obtained without such equipment.

I appeal to the Animal men in Eastern Canada to raise their sights, to extend their horizons and, as a programme for immediate action, to pool their resources wholeheartedly, all with a view to making Animal Husbandry still more worth while to this country.

Secretary's Report

L. C. McOuat

General Agricultural Agent for Eastern Canada, Canadian Pacific Railways, Montreal, P.Q.

Inasmuch as I have acted as Secretary of this Society since its organization in 1926, I feel like making certain observations which you may wish to consider and deal with at our business session to-morrow.

The object of this Society is to afford opportunity for the discussion of problems of common interest in animal industry and to encourage collective consideration of methods of investigation and instruction in Animal Husbandry.

Today there is a steady demand for results of an economic nature known as applied science. For example, what are the major problems in horse production, beef cattle production, dairy cattle production and sheep and swine production? How much specific information can we collectively bring to bear on the solution of these problems? In regard to the information that is lacking, are steps being taken anywhere to secure it? If not, why not? Have our extension workers at their disposal specific and reliable information to assist them in solving the farmers' problems? Are our experimentalists familiar with the many unsolved animal husbandry problems with which the extension worker comes in contact?

Ours is a new Society with nothing in the way of precedent to guide us. At our organization meeting, on November 17, 1926, in Toronto, it was the opinion that the most good could be accomplished in the first instance by setting up standing committees on each class of live stock production. It was expected that these committees would review their respective fields of production and indicate those problems which were in most pressing need of solution, the information already available in regard thereto, and also that they would recommend the steps to be taken to ensure getting the desired information. If such were done, much would be accomplished in the way of concentrating our attention on problems of major economic importance. Furthermore, it would result in a definite step forward in the field of coordination and standardization of methods.

At our first annual meeting our chairmen of standing committees were complimented on the excellence of the reports submitted indicating the scope

of work in each field. If you will permit me, I shall quote from Resolution No. 3, passed at the general meeting in Quebec, in 1928, as follows:— Such analysis of the general field of work is of particular value at the first annual meeting and should form a useful basis for future work of Committees, and it is believed that with the general foundation now laid we have arrived at the point where specific problems may be dealt with progressively from year to year. Be it, therefore, resolved that in future the reports of committees should deal with the specific field covered by the committee in the previous year and recommendations as to the particular problems to be dealt with in the ensuing year.

I am of the opinion that the meeting, in the above resolution, declared for a policy which will mean the most in the development of Animal Husbandry work. However, I am not certain that the best machinery was created for the accomplishment of this objective.

Standing committees with members too widely scattered addressing themselves to too wide a field of endeavour are not likely to effect the greatest accomplishments. Two years ago, I made the suggestion that the Society as a body decide on specific problems, and that these be allotted to one-man committees with the privilege of adding additional members at the discretion of the man who had been charged with the work. The executive could probably assist materially in many instances in seeing that members charged with an important piece of work receive the necessary facilities and assistance to carry out same.

Pasture Rejuvenation

C. F. Bailey

Superintendent, Dominion Experimental Farm, Fredericton, N.B.

In the spring of 1928 the Fredericton Experimental Station undertook to determine if the Hohenheim system of pasture rejuvenation would prove effective under Maritime conditions. For this purpose four 3 acre pasture fields in close proximity to the pasture areas already referred to, were fenced and in the month of April received an application of 50 pounds of sulphate of ammonia, 350 pounds of superphosphate and 100 pounds of muriate of potash per acre. Immediately following the first appearance of growth in the spring, 225 pounds of nitrate of soda were applied per acre. During the summer months these fields were grazed in rotation which allowed each field resting periods ranging from 8 to 12 days throughout the summer. The number of cattle pastured on this area was regulated in such a way that the grass was never permitted to grow more than 5 inches in height. This pasture area carried 1.13 cows per acre whereas in former years this area would not carry more than 1 cow to two acres. The herbage of this pasture when the project started was made up largely of native grasses and weeds but as the season advanced the growth of Dutch clover became more and more apparent. In former years green feed was fed to the milch cows during the months of July, August and September, but was found unnecessary under this system of pasture management.

Results of the work on pasture improvement carried on in 1928 proved so encouraging that the pasture improvement programme was revised and enlarged in 1929. This was done mainly to determine the merits of rotationally grazed pastures as compared with those continuously grazed. An area of

15 acres was divided into six 2½ acre fields; four of these fields were rotationally grazed and two continuously grazed. One of the continuously grazed fields was fertilized and the other five were treated with 350 pounds of superphosphate and 100 pounds of muriate of potash per acre in the fall of 1928; 100 pounds of nitrate of soda per acre were applied on three of the plots just as growth started in the spring,—the other two plots received 100 pounds of nitro chalk per acre. This treatment was followed by 50 pounds of nitrate of soda or nitro chalk per acre a month later.

In former years the cows were fed approximately 5 pounds of meal per cow per day. In view of the results secured in 1928, it was decided to dispense with meal except to one or two high producing cows until the latter part of September. The cows were turned out on pasture on the 31st of May and although the season was not as favorable as in 1928, the carrying capacity of the rotationally grazed area was 1.14 cows per acre and the continuously grazed area 1.45 cows per acre. The unfertilized area carried .83 cows per acre but the results secured from this area are somewhat misleading as one acre of this area received an application of 1500 pounds of Basic slag a few years before this project was undertaken.

It will be noted that the rotationally grazed areas showed very little increase in carrying capacity in 1929 over 1928. This was mainly due to climatic conditions, the pasture season in 1928 being much more favorable. The Fredericton Experimental Station meteorological records show that we had approximately 6 inches more rain and 113 hours more sunshine in 1928 as compared with 1929. It will also be noted that less nitrogen was applied per acre in 1929.

The cost of fertilizers applied to these pastures in 1929 was approximately $10.00 per acre. From May 31 to September 27, the rotationally grazed pastures carried the equivalent of 1.14 cows for 120 days on each acre. Against this, we have a saving of five pounds of meal per day for each cow; valued at two cents per pound would be equal to $13.68 for the season, or a net saving over expenditure for fertilizer of $3.68. It is not expected that superphosphate and muriate of potash need to be applied to these pastures oftener than once in three years. Therefore, this year's results should actually show a saving over expenditure for fertilizer of $5.51 per acre. If figures were available to show the amount of milk produced on the fertilized pasture as compared with the unfertilized, we no doubt would have still further evidence of the value of fertilizing of pastures. Unfortunately 2½ acre fields will not carry sufficient cattle to determine this point with any degree of accuracy. Although, as had already been stated, the season was very dry resulting in most pastures being short, we found it unnecessary to feed green feed to the cows during the months of July and August. This meant a considerable saving in time and money and will be readily appreciated by every progressive dairyman.

It will be noted that the carrying capacity of the continuously grazed area proved to be very much greater than the rotationally grazed areas. This was not expected and can only be attributed to the possibility of this particular area being in a somewhat better state of fertility before the experiment was begun, although this was not apparent at the time. The location of the continuously grazed area in this experiment will be changed from year to year

in order that reliable data on this point may be secured over an average of years. In any case it suggests that the rotation of pastures which appears to be an important part of the Hohenheim system, may be eliminated under our conditions, and if so, it will greatly reduce the cost of putting this method of pasture improvement into practice and greatly increase the likelihood of it being generally adopted by farmers in Eastern Canada.

The pasture improvement programme at the Fredericton Experimental Station, is being continued this year and duplicates the plan outlined in 1929 with the exception that the application of phosphate and potash has been dispensed with. Nitro chalk and nitrate of soda at the rate of 150 pounds per acre, are the only chemicals used. Although we experienced lack of moisture and very cold weather in the month of May, the cattle were put on pasture earlier than usual. There has been an abundance of grass of high quality and we have experienced great difficulty in supplying sufficient live stock to keep this area closely grazed. Twenty-five head of cattle are being pastured on 12½ acres of improved pasture land; 34 sheep and 29 lambs have been called in to assist. All live stock grazing on this area are in excellent condition. Milch cows are milking well in spite of the extreme hot weather we have experienced and even the high producing cows refused to eat grain in the stable. If weather conditions for the balance of the season should compare favorably with those of an average year, the prospects are that the carrying capacity of these pastures will be somewhat greater than in the former years.

In summarizing our pasture rejuvenation work at the Fredericton Station, let me especially emphasize the following points:

(1) *The application of a balanced fertilizer is necessary for best results in pasture improvement.* While the application of acid phosphate, potash and lime used singly or in combination may result in some improvement in the growth of grass the action is slow. The presence of available nitrogen especially in the early spring seems to be essential to the rapid growth of grass. The formulas used and the rate of application will naturally vary somewhat according to circumstances. It is apparent, however, that pastures in a fair state of fertility will give more economic returns from heavy applications of fertilizers than would be secured from less fertile areas. In other words, the application of fertilizer may be increased annually as the pasture improves in fertility and productivity.

(2) *The importance of close grazing.* Dr. Shutt, Dominion Chemist, as well as research workers in Great Britain, have shown that young grass is rich in protein and low in fibre as compared with older grasses and also has the advantage of being more palatable. The aim should be to have a June grass condition throughout the entire pasture season.

(3) *Harrowing is an essential part of the pasture improvement programme.* As the carrying capacity of the pastures increases, the droppings from the animals presents a problem. If pastures are harrowed at intervals throughout the season, loss of grass through becoming too rank will be avoided and an even state of fertility will be maintained thereby.

(4) *Rotation of pastures will be modified to suit the situation on each farm.* This will be regulated largely by water supply, the number of fields

available and their proximity to farm buildings. Where this system can be followed it will no doubt prove advantageous but does not appear to be essential to pasture rejuvenation.

(5) *The desirable effects appear to be accumulative.* The character of the sod on fertilized pasture areas improves almost at once and continues to improve each year. The root system of all plants becomes deeper and denser adding greatly to the capacity of the plants to produce abundant forage. There is also convincing evidence of the plants' ability to withstand drought to a much greater degree. Each succeeding year the less desirable plants are crowded out and open spaces become filled with desirable ones while Dutch clover seems to gradually predominate. Many of the more desirable plants are present in the unimproved pastures but remain in seclusion through lack of sufficient plant food.

Cross-Breeding of Swine

W. R. Reek

Superintendent Ontario Government Experimental Farm, Ridgetown, Ont.

That the crossing of breeds of animals tends to increase the vigor of the offspring and the ease and cheapness of production has long been believed and accepted by a great many stockmen. Experimental evidence has not been available; consequently the value of such a method has been determined largely by observation rather than by carefully controlled tests.

Cross-breeding of hogs has been carefully studied by some institutions and only rather casually by others. The results indicate that further definite and carefully planned work is necessary. The problem is one of many angles and cannot be disposed of by other than a series of carefully supervised tests. Costs are easily arrived at under simple tests but the question of which breeds mate best becomes very complicated due to strains within the breeds and injustices or credits may be unduly, though honestly, given.

Undoubtedly the number of litters in the study presented is too small for definite conclusions or for valuable comparisons. When the work now under way is completed, there may be a sufficient number of cross-bred litters to give a working knowledge of the possibilities.

Such results may then be compared to the compilation made by the late Professor Toole regarding prolificacy of the various pure breeds of swine.

Costs are difficult of determination as demonstrated by the various experiments. Variations are great and, in fact, often so wide that the average producer would readily enquire the cause and an informative answer without a long series of tests might not be forthcoming. An average of the costs of production of all the purebreds as against the crossbreds in the tests mentioned previously shows so small a difference that it may be eliminated for practical purposes. In some of the tests more definite information about the breeding would undoubtedly throw considerable light upon the results and again perhaps further complicate the problem. The test at Lethbridge shows rather definitely the influence of the cross in the economical feeding and the grading when marketed, but the profits due to variation of quality are not included.

The test at Guelph included pigs from various sources in order to have more strains represented. In the Lacombe series many families were included

and the averages should be of greater value to the producer. It would appear that owing to the greater ability of some to assimilate food more readily and more cheaply that large numbers of pigs should be tested before too definite conclusions are drawn in order that the influence of some few strains might not dominate the results.

In every case, except Guelph, the crossbred hog was reported as being more thrifty and an earlier maturing animal; at Saskatoon they matured from three to seven weeks earlier than the pure-breds whereas at Guelph the pure-breds gained 1.29 lbs. as against 1.19 lbs. per day for the crossbreds.

The pig which may produce a pound of pork the cheaper may not be the most profitable when placed upon the market under the present marketing conditions because quality of the finished product cannot be overlooked.

Throughout, the quality of the crossbreds was lower than of the pure-breds. This was true at every station except Lacombe and Saskatoon. At Calgary Exhibition a crossbred sow and barrow of the same breeding won first in their respective classes. Three times five bacon barrows from Saskatoon won first alive and dressed—this is rather an unique winning and speaks well for the possibilities of the crossbred pigs. The reports from other stations and of many of the Lacombe pigs indicate lower quality than Yorkshires; they do not generally conform so well to the bacon type—this, however, should not be charged altogether to the mere fact of crossing the breeds but to deficiencies in conformation of the particular sires or dams or strains. In many cases breeds were used that are not recognized as bacon breeds.

Perhaps some breeds cross to greater advantage than others and undoubtedly is this true from the standpoint of a quality product. Again numbers and averages are of paramount importance.

The Mineral Feed Problem with Dairy Cattle and Swine

AND

Nutritional Discoveries in Relation to Livestock Feeding Practices*

G. Bohstedt

Professor of Animal Husbandry, University of Wisconsin, Madison, Wis., U.S.A.

Statistical Analysis of Comparative Feeding Trial Data †

E. W. Crampton

Assistant Professor of Animal Husbandry, Macdonald College, P.Q.

Report Horse Committee

C. M. McRae

Chief, Horse Division, Dominion Live Stock Branch, Ottawa.

This report includes a statement of the work accomplished under the following policies: Federal-Provincial Stallion Premiums, Horse Breeding Stations, and Grants to Horse Parades, Ploughing Matches, and special

*These two papers, presented by Dr. Bohstedt at Wolfville, were printed in full in the October, 1930, issue (Volume XI, No. 2) of *Scientific Agriculture*.

†This paper, presented by Prof. Crampton at Wolfville, appears in full on page 281 of this issue of *Scientific Agriculture*, Volume XI, No. 5.

Horse Shows. Work recently inaugurated includes the establishment of policies on Uniform Stallion Laws and Federal-Provincial Inspection. Further development of special horse classes and clubs is also considered.

In 1929 a Boy's Colt Class was held at Brandon. Fifty percent was awarded the Colt for conformation, etc., and fifty per cent for the boy's own work in feeding, fitting and showing. Last March this was sub-divided into a Boy's Horsemanship Class where the prizes were awarded on the condition of the Colt, the way he was fitted and the manner in which he was shown and a second class for best colt, divided into two sections, the first for Clydesdales and Shires, and the second for Percherons and Belgians. These classes have aroused a great deal of interest and already western boys are preparing for nextyear. This looks good for the future as a Horse-boy becomes a Horseman. It is hoped that similar classes can be started at Winter Fairs and Spring Shows, in the East, Ormstown and Amherst being two that suggest themselves as suitable. The Province of Quebec has made another suggestion, viz, that the Dominion Live Stock Branch join with the Provincial Department in financing on a fifty-fifty basis, Draft Horse Breeders' Clubs, each Club to consist of at least twenty-five members; each Member to be allowed to enter one or two mares with their colts and each Club to run at least four years. The first year the Show will consider approved brood mares; the second year brood mares and their colts, while in the fourth year there would be brood mares with foals, yearlings and two-year-olds. This policy is now being worked out by the Federal and Provincial Departments and it is expected, with minor changed, to be accepted.

The Chairman of the Quebec Committee in his report draws attention to certain facts which are very much to the point, and apply with equal force to all Eastern Provinces of Canada, viz:

(a) Importing yearly a large number of horses to supply their needs. Last year, upwards of 37,000 horses came East ofWinnipeg, which was an increase of over 12,000 over the previous year.

(b) That there is a shortage of good stallions in the Eastern Provinces but that owing to the high prices charged very few real good horses are coming into the country.

(c) That more promotion work should be done in the way of handing out information, as well as collecting same, regarding Horse Power vs. Motor Power, throughout the country, but particularly on the farms. From time to time Provincial Governments of Quebec and the Maritime Provinces have given a certain amount of aid by bringing in good Stallions, some of which were sold at reasonable prices, while others were kept for service by the Departments. Last year Prince Edward Island purchased one good stallion to stand for service for the encouragement of horse breeding. It is the intention of the Committee to bring this matter up at an early date with a view to if possible, giving further encouragement in the way of aid to men purchasing stallions, up to a specified standard. Another matter upon which your Committee has done work is Provincial legislation to prohibit the standing or travelling for service of grade, cross-bred or scrub stallions. The Quebec Committee has at last succeeded in getting legislation prohibiting

the standing for service of any but Pure Bred Stallions and sound grades that have been allowed to stand for service in the past. This means that no new grades are being enrolled and accordingly in the space of the next few years, the horses now standing will have either died or be eliminated by inspection for unsoundness. Ontario some years ago eliminated all but Pure Breds. It is hoped that something may be done in the Maritime Provinces during the next two or three years to remedy existing conditions. In passing it might be said that some useful work has already been done.

The Committee are of the opinion that the horsemen of Canada have lost a great deal by failing to recognize the fact that advertising pays. Undoubtedly the Percheron Breeders are the most aggressive in advertising their breed all over Canada, with the result that they have rapidly come to the front. Even in Ontario, once the stronghold of the Clydesdales, they are rapidly taking first place. The Annual Report of this Society shows that they are working hard and hard work will get results. No opportunity is left to advertise the breed and accordingly the breed is increasing in numbers. If all horsemen would join together irrespective of breed, and advertise Horse Power, there would be an entirely different story to tell. In short what is wanted are horse advertisers in each Province to sell the horse idea just as manufacturers are advertising mechanical motor power. The facts and figures will bear comparison. This is another phase of the work which the Committee proposes to take up during the coming year.

Report of the Beef Cattle Committee

R. S. Hamer

Chief, Cattle Division, Dominion Live Stock Branch, Ottawa.

At the meeting of the society held at Quebec in June 1928, the discussion on the report presented at that time was summed up in the following resolution:—

> Moved by S. E. Todd, seconded by S. J. Chagnon, "That the Eastern Canada Society of Animal Production endorses the recommendation of the Beef Cattle Committee in regard to the need of survey and investigational work to obtain definite information on beef production costs under varying farm conditions and systems of management, and therefore recommends that a sub-committee of the Committee on Beef Cattle be appointed by them to give special and immediate attention to the obtaining of such required data in an organized way."

The Beef Cattle Committee subsequently appointed by the society consisted of Messrs. J. C. Steckley, E. W. Crampton, W. W. Baird, and R. S. Hamer, under the chairmanship of the latter.

It was found possible to arrange for a meeting of the whole committee in September 1928 for the purpose of endeavouring to give effect to the above resolution. After full discussion it was agreed that the most promising method of securing figures relating to cost of beef production under farm conditions lay through calf club work, and a detailed plan of procedure was drafted.

Having evolved what it considered to be a useful plan, the committee regrets to have to report that repeated attempts early in 1929 to secure Departmental approval failed. Finding that utilization of calf club work

to secure figures on cattle fed under farm conditions appeared to be officially frowned upon, the committee has since endeavoured through other channels to interest some of the institutional farms in undertaking more definite work on beef production costs. Working through the Eastern Section of the Joint Beef Committee, contact was made with a producer committee which had been appointed to interview Dr. Christie and the Ontario Research Foundation. With the support which it has had, the latter committee has been able to make considerable progress in having organized research into relative costs of beef production under different conditions undertaken at the Ontario Agricultural College.

Advantage was also taken of an opening created by the resolution received by the Dominion Department from the Saskatchewan Stock Growers' Association to interest the Experimental Farms Branch at Ottawa in bringing down from Western Canada in the fall of 1929 three carloads of range bred steers—calves, yearlings and two-year-olds. These cattle have been on feed at Ottawa during the past winter and being all from the one herd, some interesting figures on comparative production costs for cattle of the different ages are expected to result.

As was anticipated ,the introduction of the Beef Grading Service in the fall of 1929 has resulted in a very definite focusing of attention on the finishing of cattle at lighter weights, and under twenty-four months of age. The light weight carcass is the popular one in our domestic market, and it would seem that the extent to which the outlet for good beef can be expanded in Canada will largely depend on the ability of Canadian producers to supply properly finished cattle under 1,050 lbs. in weight. This, as previously pointed out, will involve a material change in beef production practice in Canada, and it is important that those in charge of production programmes have as much up-to-date information as possible in regard to relative costs.

As was pointed out two years ago, there is need for investigational work to determine the practicability, in relation to a more stabilized market at higher price levels for finished cattle such as has existed since 1927, of raising feeder cattle in the East instead of continuing to rely largely upon Western Canada as a source of supply. This question was of course receiving definite consideration by the Experimental Farms Branch of the Dominion Department, and it was hoped that a start would be made in such work during the current year.

In view of the increasing interest which is being taken in production costs in all lines of agricultural and particularly live stock products, it should be easier during the next few years to make progress with the two specific questions which were referred to the present committee two years ago, and it is recommended that they be kept prominently on the agenda of the incoming committee.

Report of the Dairy Cattle Committee

Alex. R. Ness
Assistant Professor of Animal Husbandry, Macdonald College, P.Q.

The task to which our attention has been directed has to do with the possibilities of mineral deficiencies in dairy rations and we have, by reason

of their importance, elected to deal only with possible deficiencies of calcium and phosphorus. This field of work was chosen because of:

1. The prominence and economic importance of certain nutritional disturbances reported in this and other countries considered to be attributed to or associated with calcium and phosphorus deficiencies.
2. The wide spread interest and attention being given the question of pasture improvement particularly since the beneficial results to date indicate an association with the ash content of the forage grown.
3. The growing appreciation of the requirements of these inorganic constituents in the rations of dairy animals together with the evident metabolizable difficulties especially when administered in supplemental form.
4. The advisability of preventing calcium and phosphorus deficiencies, if they exist in Canada, from assuming the acute and pathological conditions that they have in certain sections of our country.
5. The urgent need for more fundamental data on the subject of mineral metabolism.
6. A sincere hope that some Canadian institutions find it possible in the very near future to undertake work on this important problem.

The program of the committee was to review the available data on the subject and to collect as much local information as possible and present the results in the form of a report to this Society. Since the adoption of this program there has come from the press a booklet entitled "Minerals in Pastures and their Relation to Animal Nutrition," by the eminently qualified authority, J. B. Orr, D.S.O., M.C., M.A., D.Sc., M.D., of the Rowett Research Institute, Aberdeen. This book is a review prepared by Dr. Orr after an exhaustive search of the literature on the subject, and serves the purpose your committee has in mind most admirably.

The dairy cow is a most efficient producer of a product rich in calcium and phosphorus and she is constantly being selected for early maturity and higher production. This continued selection has probably removed the dairy cow somewhat from the field of function which nature has originally intended. With the increased standards of output, it is most wise that we consider the related requirements of intake of inorganic as well as organic constituents.

The fact that the same crops grown under different environmental conditions and upon soils of varying fertility will differ in ash content, makes it necessary that dairy cattle feeders do more than follow blindly the recommendations outlined. It has been pointed out very definitely by Dr. Orr that one of the great differences shown by the analysis of so called good and poor pastures is the high ash content of the good and the low ash content of the poor pastures. With these very brief observations, I believe we can ask the following questions: What is the mineral content of the hays we grow and feed in the more intensified dairy sections of this country? Are we actually feeding the amounts of calcium and phosphorus in our rations that we think we are when for example alfalfa or clover hay is fed? How serious is the situation when only timothy or hay from other grasses is available which, by the way, is the case more often than we choose to admit?

With questions of this sort in mind, it was proposed that we collect and have analysed for calcium and phosphorus as many representative samples of hay as possible. These samples were to be taken from long established but successful dairy farms. It was not expected at the outset, owing to the work involved in making these determinations, that large numbers of samples would be analyzed, however, we had hoped for more than was actually accomplished in this respect. The work of the first lot including nine timothy and four clover samples was completed. The second lot of fourteen timothy and twelve clover samples which was added and which we hoped to be able to include in this report, since the Society did not meet last year, has unfortunately not been sufficiently completed to be included in this report.

TABLE 1.—*The calcium and Phosphorus content of timothy and red clover hay.*

Sample Number	Parts per 100 Dry Matter			
	Moisture	Ash	Calcium	Phosphorus
T1	7.32	5.12	.221	Not sufficient sample
T2	6.64	3.07	.153	0.144
T3	8.03	4.76	.117	0.096
T4	6.84	4.89	.099	0.097
T5	6.74	4.22	.080	0.126
T6	6.63	6.60	.098	0.149
T7	7.86	5.73	.099	0.087
T8	8.22	5.25	.043	Nor sufficient sample
T9	8.69	6.25	.060	0.194
C1	6.78	5.09	1.316	0.143
C2	8.70	7.31	1.079	0.213
C3	8.45	7.51	1.248	0.178
C4	8.97	6.45	1.043	0.163

An examination of table 1 gives evidence of considerable variation in the calcium and phosphorus content of both timothy and clover hay. The percentage of calcium in the dry matter of timothy hay ranged from .043 to .221, which represents a difference of over five times or 500 per cent. The percentage of phosphorus in the timothy ranged from .087 to .194 which represents a difference of almost two times or 200%. The percentage of calcium in the dry matter of clover hay ranged from 1.043 to 1.316 which represents a difference of one quarter times or 25 per cent. The percentage of phosphorus in the clover ranged from .143 to .213 which represents a difference of almost one-half times or 50 per cent.

In order to have some standard with which to compare the figures shown in table 1, I have taken from "Feeds and Feeding" eighteenth edition 1923, by Henry and Morrison, page 752, the figures representing the pounds of calcium oxide and phosphoric acid in 1000 lbs. of timothy and clover hay, and calculated from them the percentages of calcium and phosphorus in 100 lbs. of dry matter, which makes the figures presented in table 1 and table 2 directly comparable.

TABLE 2.—*The calcium and phosphorus content of timothy and red clover gay.* (Henry and Morrison).

	Parts per 100 Dry Matter	
	Calcium	Phosphorus
Timothy Hay	.202	.153
Clover Hay	1.302	.196

In comparing the contents of table 1 and table 2, it is evident that only the timothy and clover samples registering the highest percentage in each case in table 1 actually stand above the figures given in table 2. The remaining percentages are below and most remarkably below. It is not possible to even attempt to answer the questions previously presented as obviously definite conclusions can not be drawn from such limited evidence. Nevertheless, the results of the analyses reported are indeed suggestive of the possibilities of calcium and phosphorus deficiencies. More references could also have been cited. The one chosen was selected because of the fact that the book "Feeds and Feeding" is so extensively used as a text by Animal Husbandry workers. Furthermore, other references show a wide variation in both calcium and phosphorus content, in fact, equally as wide as that shown in table 1—all of which points to the necessity of further work of a fundamental character.

I feel that I am expressing the desires not only of each member of the Committee but of each member of the Society when I venture a hope that in the near future, adequate facilities be provided in order that the dairy production specialist, the physiologist and the biochemist can unite and work unrestricted on this nutritional problem.

I wish to acknowledge the indebtedness of this Committee to Dr. R. R. McKibbon of the Chemistry Department of Macdonald College, who with student specialists in chemistry are responsible for the analytical work involved.

REPORT OF SHEEP PRODUCTION COMMITTEE

A. A. MACMILLAN

Chief, Sheep and Swine Division, Dominion Live Stock Branch, Ottawa.

In the last report, it was pointed out that the industry provided problems of a very varied character, including firstly, the problem of lamb production and wool production; secondly, feeding problems; thirdly, domestic and exports markets for both wool and lambs, and fourthly, parasites. Since our last report was made, higher tariff barriers on both wool and lambs have further restricted market outlets to the United States. Fortunately, Canadian wools have found a larger market outlet in Great Britain and Canadian mills are continuing to use very considerable quantities of Canadian wools for Canadian manufactured goods. Industrial development in Canada, combined with an increased tourist trade, has had a very definite effect on increasing Canadian consumption of lamb.

Many of the original suggestions of this Committee have already been acted upon. The Sheep Fair and Market Lamb Sale Policy has been extended. The Boys' and Girls' Sheep Club Policy has been applied quite

extensively in a number of the Eastern Provinces, supplemented in the Province of Ontario by the demonstration flock policy. The Ram Premium Policy continues to aid in the more general use of pure bred rams for grade flocks. In 1929, a further importation of pure bred rams was made from Great Britain, mostly for the Provinces of Quebec and Ontario, and this year a further importation is being made from Great Britain for the Province of Ontario. The Ram Grading service has been made use of in all the provinces, except Prince Edward Island. Special publicity for Canadian lamb was initiated at the special lamb week following the Montreal Lamb Show held last Fall. In order to provide for this increased volume of promotion work, it has been necessary to increase the promotion staffs, both Provincial and Federal in the various Provinces and, this year, further encouragement to sheep production in the Province of Quebec has been provided by the establishment of six coöperative livestock market promoters, three having been appointed by the Provincial Department of Agriculture and three by the Federal Department of Agriculture. In all promotion work, there now exists very close coöperation between Federal and Provincial Departments of Agriculture.

A new feature of commercial wool grading was introduced by the Federal Department in 1929. It has always been realized that the purebred flocks must continue to be the basic source of wool improvement throughout the Dominion, particularly as purebred rams were being sold from these flocks for use on grade flocks. A special purebred wool grading statement, and fleece identity tags were accordingly prepared, following which the purebred breeders were advised that the identity fleece tags could be secured upon application and that such lots of wool when forwarded for grading would be handled by a special wool grader. A large number of breeders made application for tags and when their wool was shipped for grading the individual fleeces were weighed and graded separately. In this way it was possible to indicate to purebred breeders those ewes which graded too low for the breed, those which were light in weight or those which carried black fibres. This service is being continued in 1930 and already many breeders have culled out numbers of undesirable ewes or have purchased rams of superior individuality. The data accumulated from this work may at a later date provide the basis for more scientific genetical studies in wool improvement as related to purebred flocks.

During the last year or so, Mr. Muir states that owing to the fact that sheep work at the Experimental Farms Branch has been more or less in the transition stage, nothing elaborate in the way of sheep experimental work has been attempted. In the meantime flocks have been improved and now with better laboratory equipment and the recent appointment of a special investigator, plans are being completed for the carrying out of extensive sheep experiments this fall.

Committee on Swine

G. B. Rothwell

Dominion Animal Husbandman, Central Experimental Farm, Ottawa.

The great need in farming today is probably a better appreciation of the fundamentals, the intelligent application of methods known to be sound

and reliable years ago. The tendency is to look for something new and it is this tendency, after all, that has ever constituted the whole spirit of advance. Nevertheless, after probing through the intricacies of scientific agriculture in all its phases, struggling through the bogs and quicksands of politics, and groping through the maze of economics, agricultural and otherwise, as affecting the present situation,—one comes back finally to the belief that the only way to remain on the farm today is to pay a little more attention to the fundamental principles that maybe our fathers appreciated better than we do, even though they lacked knowledge of many of the reasons why, such as are common property today, even to the junior agricultural student.

The swine business might be considered in much the same light. Admitting that grave problems have been unearthed and tackled of recent years,—grading as a corrector of lack of uniformity in product and as placing a premium on desired quality; the realization of the importance of strain and individual in breeding stock as affecting subsequent market type; parasitism, etc., the basic and underlying defects in the business today are the same as twenty years ago.

(1) The in and out breeding policy on the part of the farmer is just as evident as ever it was, with the usual result.

(2) The packer is blamed, whether rightly or wrongly, for the slump which follows the upward cycle of production.

(3) Whether or not the farmer is to be blamed for his spasmodic effort in swine breeding is doubtful; it is a business or side line started with the minimum investment and equipment and liquidated with the minimum loss. Other classes of stock do not lend themselves to this policy. Under present arrangement or manipulation, his high level swine production apparently can not be maintained at what he considers remunerative prices.

(4) Little or no attempt is made to study practical production costs; to follow a designed and closely followed scheme of live stock farming, into which the pig enters as the regular consumer of a by product specially and regularly produced for him; to consider the home production specially for swine of such crops as barley in particular, of corn in a lesser degree, of roots and alfalfa, and last, but by long odds most important of all, milk by products. The in-and-outer employs a haphazard rather than a designed policy as regards production and the cost thereof.

(5) Considering that the ration of the market hog is made up of a higher percentage of grain or meal than applies to any other class of farm live stock, present high freight rates operate as a distinct detriment to low cost swine production, particularly in the Maritime Provinces. The same Canadian produced feeds sell at approximately the same levels in European countries as in Eastern Canada, these countries competing on the same market with the final product.

(6) Insofar as swine products are concerned, we have increased consumption and reduced production until the two now balance. Export business is negligible.

While many more points might be listed as bearing on the present situation, the foregoing enumeration may suffice to indicate that in the writer's opinion, at least, the causes are to a certain extent economic or of

a fully practical nature. Admitting the ever present necessity for investigation and research, the greater problems today would seem to lie in the field of economics and in the closer study and better appreciation of the conditions applying at present, and of what already has been well demonstrated as good practice.

There is need for much more intensive study of breeds, strains and the pig as a breeding unit. The preliminary discussion by this Committee had more or less to do with the final working out of the policy of Advanced Registry of Swine, a policy now in its infancy, unique of its kind, subject to change, but of considerable promise.

There is need of better appreciation of the effect of parasitism in swine, and of the utilization of practical methods of control now recommended. Good work has recently been accomplished in the development of vermicides more simple of administration. The bulletin on parasites of sheep and swine, which is to be distributed by this Society, should help toward a better understanding of these problems in Eastern Canada.

More information is needed concerning anemia in little pigs.

More specific information would seem necessary concerning the limits to which the pig (and other classes of stock) might be regarded as a concentrator for various rocks and mineral substances in their raw state, these mixed with divers forms of junk and sold as mineral supplements. In the writer's opinion, the pendulum of live stock mineral requirements has swung very far in the direction of excess.

There may be a need for review of the whole question of cross breeding in swine and the effect of such practice on market type and economy of production generally. It is noted that a discussion of this phase of swine breeding appears on the program of this meeting.

Committee on Animal Health

Dr. A. E. Cameron
Chief Veterinary Inspector, Health of Animals Branch, Ottawa.

Since the report of the Committee on Animal Health which was made by Dr. Lionel Stevenson, at Toronto, on November 28th, 1929, your committee met in Ottawa, on November 28th, 1929, and on March 13th, 1930.

A bulletin on sheep parasites was prepared by Dr. Stevenson and your committee read over this manuscript together and after some changes were made to adopt the bulletin particularly for the use of sheep owners, it was forwarded to the secretary with the recommendation of their committee that it be published for distribution to sheep owners in Eastern Canada.

A bulletin on Swine Parasites has also been prepared by Dr. Stevenson and has been submitted to the Committee, and a final manuscript is being prepared for submission to the society with a view to its publication.

As the problem of parasites is one of the most important with which the stockman has to contend, your committee is of the opinion that the dissemination of information on this subject is of primary importance.

The subjects outlined in the last annual report of this committee will be studied and, if possible, bulletins will be prepared for consideration as opportunity arises.

A NOTE ON MODERN METHODS IN FERTILIZER MANUFACTURE

B. Leslie Emslie *

With the growing popularity of fertilizers in Canada, this country is keeping pace with the progress made in Europe and the United States in new, improved methods of fertilizer manufacture. Indeed, within thirty miles of Montreal, there is now a fertilizer factory of the very latest design and equipment where superphosphate is being prepared by a new patent process that ensures a product distinctly superior in chemical and physical condition to that produced by the ordinary "den" method.

The importance of superphosphate can be appreciated when one considers that this material forms from 50 to 60 per cent of the bulk of the fertilizer mixtures on the market today, and the imports of superphosphate to Canada, from the United States and Europe, have reached the total of 100,000 tons annually.

For many years there has been no manufacture of superphosphate in Canada, with the exception of one plant producing it in British Columbia, for the reason that the cost of production, in view of the hitherto rather limited demand, was too high.

Now, with the increased consumption of fertilizers and an available supply of cheap sulphuric acid—recovered from another process—for the acidulation of phosphate rock, it has become possible to produce economically superphosphate of superior grade, in Canada.

This new superphosphate process permits the preparation of the material in one operation, in a single apparatus, constituting a distinct step forward from the old "den" method which Lawes introduced at Deptford, England, in 1858. This same method, with but few changes, is still the standard process, and the product, on removal from the den, requires from two to three months to "cure".

The many advantages of the new process are apparent, and the dry, finely granular superphosphate imparts its desirable chemical and physical qualities to the fertilizer mixtures of which it forms the basis. The physical condition of the fertilizers, thus prepared, ensures their easy, uniform application and distribution in the soil.

Another process, adopted recently in the fertilizer industry, is the ammoniation of superphosphate through the introduction of either aqua or anhydrous ammonia. The advantages of the process are: (a) a cheap source of nitrogen, (b) a more concentrated fertilizer and (c) a drier and well conditioned mixture. This ammoniation process became an economic possibility when the unit cost of producing ammonia synthetically was reduced below the current price of nitrogen, or ammonia, in other forms.

Ammonia is now being produced synthetically in Canada, but there is a considerable domestic output of by-product sulphate of ammonia, a large portion of which is exported. The export of the material, however, is becoming annually smaller in proportion to the amount consumed in Canadian agriculture, and very soon the quantity may be expected to prove inadequate to supply the demand.

*Manager, Fertilizer Department, Canadian Industries Ltd., Montreal.

Nitrate of Soda continues a popular nitrogenous fertilizer, especially in its new granular form and convenient 100 lb. package.

Nitro-Chalk, the newest nitrogenous fertilizer, contains 15½ per cent of nitrogen—half as nitrate and half as ammonia—and 48 per cent of carbonate of lime.

The federal and several provincial departments of agriculture are now active in providing farmers with instructions in the use of fertilizers, and there is every indication that the output of the industry will be doubled within the next five years.

Interior of a Modern Fertilizer Manufacturing Plant.

REUNION DE LA SECTION DE MONTREAL

Diner-Causerie

Le 29 novembre, la section de Montréal de la Société des Agronomes canadiens se réunissait au Cercle universitaire de Montréal. L'hôte d'honneur était l'honorable Honoré Mercier, Ministre des Terres et Forêts dans le gouvernement de la province de Québec.

Le conférencier devait être M. C.-J. Piché, chef du service provincial des forêts. Empêché de se rendre au diner-causerie à cause d'une indisposition, M. Piché s'en excusa au président par un télégramme. L'hôte d'honneur, l'honorable M. Mercier, à la demande du président, accepta d'être aussi le conférencier du jour.

La réunion s'est tenue sous la présidence de M. P.-N. April, agronome du comté de Chateauguay, président de la section de Montréal des Agronomes canadiens. Disons, en passant, que M. April a été dernièrement élu maire de la paroisse de Ste-Martine. C'est un honneur pour M. April, et nous tenons ici à l'en féliciter, M. April, dans son discours d'ouverture, rappela le souvenir de deux grands disparus de la classe agricole, M. J.-E. Caron et M. J.-L. Perron, dont le coeur et l'esprit aimaient et comprenaient la noble profession d'agriculteur. Le président promit ensuite au nom de ses confrères sa collaboration sincère et dévouée au nouveau ministre de l'agriculture, l'honorable Adélard Godbout, dont les connaissance techniques en font le chef tout désigné de la grande famille agricole. M. April expliqua ensuite l'absence du conférencier, M. C.-J. Piché, et invita l'honorable M. Mercier à prendre la parole.

L'honorable M. Mercier exprima d'abord ses regrets pour les deux grands citoyens que la mort a fauchés des rangs: les Hon. Caron et Perron: le premier, qui a donné aux choses agricoles leur orientation vers le progrès; le second, qui a donné un si bel exemple aux Canadiens-Français: parti des bords du Richelieu, d'une humble famille, il s'est élevé par son travail et son énergie au sommet des affaires et du monde social. Il a prouvé par des actes que le Canadien-Français, aussi bien que tout autre, est apte aux affaires. Il a donné à la voirie le meilleur de son temps; il est tombé à la tâche, comme le soldat vaillant, à une heure où sa carrière était dans son plus bel épanouissement. Puis l'orateur salue la nomination de l'hon. A. Godbout, homme d'idées, d'éloquence et de jugement, et il ajoute que l'agriculture verra de beaux jours sous son administration. Passant ensuite au Department des Terres et Forêts, l'orateur affirme que ce Département doit avoir plus d'un contact avec le monde agricole, et il énumère les principaux travaux que fait le Ministère en collaboration avec les agronomes. Il traite de la classification difficile des sols agricoles, faite par une Commission spéciale: terres qui doivent être laissées en forêt ou livrées aux sueurs du colon. Le but de la Commission est de donner satisfaction à tous les esprits justes. La tâche des agronomes est vaste et noble: faire l'éducation agricole des fermiers de cette Province. Il est vrai qu'en agriculture les progrès sont lents, mais l'éducation est un moyen infaillible de résoudre les problêmes. En terminant, l'hon. Ministre rend hommage au mérite des agronomes; il reconnait les difficultés qu'ils ont eues à renverser et les immenses services qu'ils ont rendus à la Province, et les en remercie cordialement au nom de tous les citoyens du Québec.

M. Aimé Gagnon, professeur à l'Institut Agricole d'Oka, présenta les remerciements des agronomes au distingué conférencier. M. Gagnon dans son allocution fit allusion au travail du début des agronomes. La mentalité des cultivateurs, a dit M. Gagnon, est aujaurd'hui tout autre. Les cultivateurs ont maintenant confiance dans le travail des agronomes et ils recherchent partout leur direction. M. Gagnon termina en émettant le voeu qu'un contact plus intime règne entre le travail que poursuit le Ministre des Terres et Forêts et celui que poursuivent les techniciens agricoles. Dans la classification des terres, a fait remarquer entre autres choses, M. Gagnon, les experts du service forestier et les agronomes pourraient s'entre-aider et collaborer pour le plus grand bien des intérêts forestiers et agricoles.

Erratum

Dans le numéro de décembre 1930 de la Revue deux articles ont été publiés aux pages 238 et 239. Malheureusement le temps ayant manqué pour revoir les épreuves, des erreurs importantes se sont glissées dans le texte des articles. Nous espèrons que les lecteurs de la Revue ne nous en tiendront pas rigueur et auront corrigés d'eux-mêmes ces erreurs. Le Secrétaire-Général espère aussi que le blâme n'en retombera ni sur l'auteur si sur le rédacteur français ; le temps a manqué pour envoyer une épreuve au rédacteur français, et bien que quelques-unes des premières fautes d'impression aient été corrigées, il y en a eu d'autres des faites lors de l'impression définitive.

Pour éviter de couper en deux un article du Dr Henri L. Bérard nous retarderons la publication de la première partie de l'article jusqu'à février et publierons l'article entier dans un numéro. Ceci explique le peu d'espace donné ce mois-ci à la section française de la Revue.

CONCERNING THE C.S.T.A.

Notes and News

E. H. Buckingham (Alberta '21) has been appointed Assistant Field Crops Commissioner, Field Crops Branch, Department of Agriculture, Edmonton, Alberta. Mr. Buckingham was formerly Dominion Seed and Feed Inspector at Calgary.

L. H. Hanlan (Toronto '22) has been appointed Superintendent of the Ontario Demonstration Farm at Hearst. Mr. Hanlan secured his M.S.A. from McGill in 1924 and since that time has been Assistant Superintendent of the Dominion Expefimental Farm at Kapuskasing.

A. S. Kyle (Saskatchewan Associate '14) is now West Coast Representative of the Petersime Incubator Company and Managing Director and Secretary-Treasurer of the Poultryman's Supply Company of America, Inc. He is located at No. 8 Third St., Petaluma, California.

Hon. Manning Doherty (Toronto '95) now has his office at 170 Bay St., Toronto, under the name of Doherty-Roadhouse and Company.

A. E. Ogilvie (British Columbia '24) is now Supervisor of Cow Testing Association work in the Province of Saskatchewan with headquarters at Regina.

J. MacBain Cameron (McGill '30) is now located at Stellarton, N.S.

R. E. Johnson (McGill '30) is now at 236 Campbell Ave., Montreal.

Charles H. Lavoie (Laval '24) has changed his address to Bureau de l'Agronome, St. Casimer, Cté de Portneuf, P.Q.

F. G. Corminboeuf (Montreal '27), formerly Professor of Agriculture and Science at Collége Mathieu, Gravelbourg, Sask., is now at the Oka Agricultural Institute at La Trappe, P.Q.

W. Kelvin Bunner (Toronto '23), who has been teaching at Achimota College, Acera, Gold Coast, British West Africa, for the past five years is returning to Canada next July with his wife and child. His present address is as above.

Applications for Membership

The following applications for regular membership have been received since October 1, 1930:

Thornton, H. R. (Wisconsin, 1927, Ph.D.), Edmonton, Alta.

Henry, A. W. (Wisconsin, 1923, Ph.D.), Edmonton, Alta.

Woodward, J. C. (McGill, 1930) B.S.A.), Lennoxville, P.Q.

Fisher, R. A. (British Columbia, 1922, B.S.A.), Saskatoon, Sask.

Cumming, O. C. (Manitoba, 1920, L.L.B.), Winnipeg, Man.

Imperial Bureau of Animal Nutrition

Friends of Prof. R. D. Sinclair will be pleased to know that he is enjoying the pursuit of his studies in the Rowett Research Institute at Bucksburn, Aberdeen, Scotland. A recent letter from Prof. Sinclair had the following note enclosed.

"Animal Husbandry experimentalists in Canada are no doubt acquainted in a general way with the aims of the Imperial Bureau of Animal Nutrition with headquarters at the Rowett Research Institute, Bucksburn, Aberdeen.

The Bureau serves as a connecting link between the Animal Husbandry workers in the various parts of the British Empire and the summary of experimental projects under way in the Empire, which was recently issued, gives some idea of the manner in which the organization is attempting to realize its aims. Those who have studied this report have undoubtedly been enlightened as regards the number of stations engaged in animal research and the scope of the problems being studied. The Bureau is in close touch with the research work which is under way at the Rowett Research Institute and other stations in Britain and having access to adequate library facilities is in a position, and will to advise regarding special nutritional problems.

The point of contact between the Bureau and the workers in the various Dominions and Crown Colonies is the Official Correspondent, who in the case of Canada is Mr. G. B. Rothwell of the Central Experimental Farm, Ottawa."

Eleventh Annual C.S.T.A. Convention

A strong Provincial Committee has plans well under way for the Eleventh Annual C.S.T.A. Convention to be held at the Ontario Agricultural College, Guelph, from June 22nd to 26th of this year. During the next six months the College is carrying special advertising in *Scientific Agriculture* calling attention to the development in equipment and research now under way.

Present plans for the Convention call for committee meetings on Monday afternoon, the 22nd of June. It is hoped that midnight sessions of committees may be avoided to some extent by getting this work started earlier. Tuesday will be devoted to the opening sessions of the C.S.T.A. and affiliated organizations and groups. The Canadian Seed Growers' Association will hold its official sessions at the Kemptville Agricultural School the previous week and will motor to Guelph over the week-end. The Canadian Phytopathological Society has been invited to meet at Guelph during the C.S.T.A. sessions. The Eastern Canada Society of Animal Production, the Canadian Society of Agricultural Economics, the Agronomy Group and the Horticultural Group of the C.S.T.A. will probably have their special lectures and business meetings on Tuesday and Wednesday.

During Wednesday afternoon and Thursday there will be a tour of the famous Niagara Peninsula of Ontario, including the new Welland Ship Canal, Niagara Falls and the Horticultural Experiment Station at Vineland. Open lectures will be given at Vineland on Thursday afternoon. Several banquets and other entertainments are to be provided for all those in attendance as well as a special programme for the ladies. Several O.A.C. Class reunions are planned and also the annual session of the Ontario O.A.C. Alumni Association. The new Residence and Administration Building will be ready for occupation as well as several other new buildings. Programmes will be issued early in the spring giving full details.

The Ontario Provincial Committee is headed by Mr. J. B. Fairbairn, Deputy Minister of Agriculture, and includes the following men: Vice-

Chairman, Dr. G. I. Christie; Secretary, Stanley White; Professors J. E. Howitt, W. R. Graham, W. J. Squirrel, A. W. Baker, H. Fulmer, F. C. Hart, A. H. MacLennan, J. C. Steckley and Messrs. R. S. Duncan, A. W. Mason, W. A. Weir, J. A. Hand, E. F. Neff, G. H. W. Dickson, D. R. Sands, A. M. Porter, G. C. Chamberlain, E. F. Palmer, J. Laughland, J. Buchanan, M. C. McPhail, W. S. Van Every, and Miss Olive Cruikshank.

Photographs of C.S.T.A. Activities and of Late General Secretary Desired

The General Secretary desires to obtain prints of photographs showing C.S.T.A. members assembled in branch meetings, on tour of inspection, at picnics or at other informal gatherings. These should be assembled at the central office for historical purposes. Large photographs of the conventions are already on hand. Members who can spare prints from their best negatives will be doing the Society a lasting service by forwarding these. It is particularly desired that characteristic pictures of Fred Grindley be forwarded as there is an immediate need for these. In case of anyone having an especially good picture only one print of which is in existence, this will be reproduced and the print returned to the owner.

Canadian Seed Growers' Association Convention

During the week immediately preceding the C.S.T.A. convention, the series of meetings which comprise the annual convention of the Canadian Seed Growers' Association will be held. At the last annual meeting at Wolfville, N.S., the Ottawa Valley Seed Growers' Association extended an invitation to the C.S.G.A. to hold its 1931 convention at Kemptville, Ont., and this invitation was cordially accepted. The entertainment programme being arranged promises trips through the picturesque and fertile Ottawa Valley and contains much that will be both instructive and enjoyable. Kemptville Agricultural School will be the headquarters of the convention and it is situated on the Prescott Highway some thirty-five miles from the city of Ottawa.

The present tentative programme provides that all standing committees of the directorate of the C.S.G.A. will meet on Wednesday, June 17th, 1931, and the open sessions of the Association will convene on the morning of Thursday, June 18th. While no definite invitations have yet been extended to special lectures, it is anticipated that one or two papers of general agricultural interest will be presented by outstanding Canadian agriculturists and it is hoped that in addition addresses will be given on the production of seed. It is the present intention of the committee in charge of arrangements that Thursday, Friday and Saturday, 18th, 19th and 20th, will be available for the general meetings and for entertainment, and the ensuing week-end will thus be left free for delegates who are members of the Canadian Society of Technical Agriculturists and who wish to attend its convention, to travel from Kemptville or Ottawa to the Ontario Agricultural College at Guelph, Ont., where the C.S.T.A. meetings will commence on Monday, June 22nd.

The meeting place for the Dominion Conference of Plant Breeders has not yet been definitely decided upon but it is altogether likely that it will be either at Ottawa or Kemptville and the dates have been tentatively arrang-

ed as Monday and Tuesday, June 15th and 16th. This Plant Breeders' Committee is composed of three sections, namely: Cereal Section, Chairman, Mr. L. H. Newman; Forage Crop Section, Chairman Dr. G. P. McRostie; Horticultural Section, Chairman Dr. W. T. Macoun. A report will be presented by each of these chairmen giving a resume of the work accomplished by his section during the year then closing. At the business sessions such recommendations as are considered desirable will be prepared for presentation to the general meeting of the C.S.G.A.

The personnel of the committee in charge of the arrangements for the C.S.G.A. meetings is as follows: H. W. Graham, Kemptville Agricultural School, Kemptville, Ont., Chairman; J. W. Mackay, Dominion Seed Branch, Ottawa, Secretary; J. H. Findlay, Arnprior, Ont.; F. S. Caldwell, Carp, Ont.; E. H. Wallace, Bell's Corners, Ont.; N. E. Lindsay, Renfrew, Ont.; Barclay Craig, Arnprior, Ont.; H. H. cElroy, Ottawa, Ont.; J. C. Hopkins, Carp, Ont.; A. M. Barr, Kemptville, Ont.; W. A. Davidson, Perth, Ont.; W. M. Cockburn, Carp, Ont.; D. L. Scott, City View, Ont.; W. T. G. Wiener, Ottawa, Ont. (ex-officio).

International Federation of Technical Agriculturalists

At a meeting of the Fourteenth International Congress of Agriculture, which was held at Bucarest in May 1929, the Italian Syndicate of Technical Agriculturists, in accordance with the desire of their colleagues of other nationalities, presented a motion for the establishment in Rome of an International Federation of Technical Agriculturists. This motion was unanimously passed by the Assembly.

During the past year Doctor F. Angelini has been engaged in the organization of an international Conference which will examine all the problems concerning the activity and the work of the new Federation:

The Canadian Society of Technical Agriculturists was represented at this Conference by Dr. F. T. Wahlen, Director of the Agricultural Control and Experiment Station, Oerlikon-Zurich, Switzerland. Dr. Wahlen was formerly Chief Analyst of the Dominion Seed Branch and an active C.S.T.A. member, having held the position of President of the Eastern Ontario Branch. We hope to publish Dr. Wahlen's report of the International Conference.

SELECTED LIST OF ACCESSIONS TO THE MAIN LIBRARY OF THE DEPARTMENT OF AGRICULTURE, WEST BLOCK, OTTAWA.

Members of the C.S.T.A. may borrow books and periodicals postfree by addressing a request to the Librarian, Department of Agriculture Library, Ottawa.

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